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Ice creams and o.

ICE CREAMS
and other
FROZEN DESSERTS

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BY

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PREFACE

In response to the need for an up-to-date, scientific, yet easily understood book on ice creams and other frozen desserts, the authors have made a special effort to present useful facts in non-technical language and as concisely as possible.

This book concerns itself largely with the essentials which the student, the ice cream maker, the plant operator, and the salesman need in their business, and contains much of the information and experience accummulated by the authors in their many years of work with students and with those engaged in the manufacture and marketing of ice cream. The contents also include a considerable amount of handy reference material, lists of formulas, solutions of overrun problems, suggestions for sales promotion, and detailed information regarding simple methods of calculating various types of mixes.

The authors are grateful to fellow teachers, research personnel, leaders in the dairy industry, and commercial workers in the ice cream field, too numerous to mention individually, on whose work they have freely drawn. To these men and women who have contributed to modern knowledge of ice cream and other frozen desserts — how to make them — how to sell them — and their value as a food — this book is dedicated.

J. H. Frandsen

D. Horace Nelson

Amherst, Massachusetts
September, 1950.

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The publisher greatly appreciates the many helpful suggestions, the generous contribution of illustrative material, and the advertisements of individuals and firms in the Ice Cream Industry. Their encouragement has helped make this publication possible and substantially added to its value. The listing of these firms provides the reader with a convenient reference to these leaders in the field.

J. H. Frandsen
Publisher

CHAPTER I

HISTORY, DEVELOPMENT AND IMPORTANCE OF THE ICE CREAM INDUSTRY

Ice cream is often called "The Great American Dessert." Although the product is typically American, we can not claim its origin. Early history of ice cream making is very scanty; however, the product definitely is known to have been introduced from Europe. But the ice cream industry as we know it today has been almost wholly developed in the United States.

Water ices were made in Southern Europe as long ago as the 15th century. It is believed that frozen ices may have been the result of what might be called a fortunate accident. The practice in early times of cooling drinks in ice and snow containing saltpeter is a matter of record. It seems possible that in over-cooling some punches, the "ice" was discovered. At any rate various records of frozen ices have been found in European history of the 16th century. Ices are still far more popular in continental Europe than is ice cream. The first printed record of "cream ice" appeared in "The Experienced English Housekeeper" in 1769, more than 175 years ago. Since that time ice cream making has continued to grow in popularity in England though not nearly as rapidly as in the United States.

The introduction of ice cream into the United States has been credited to Mrs. Alexander Hamilton. Reference has been found in records kept by George Washington regarding the "purchase of a machine for making ice cream." Records also indicate that ice cream was advertised by New York retailers as early as 1777 but the bulk of ice cream making remained a household task until 1851 when Jacob Fussell, a Baltimore milk dealer, started the first business of wholesale ice cream manufacture. Ice cream at that time was definitely considered a luxury and early prices were as high as $1.25 per quart. In fact, until about 1920 ice cream was associated with candies and other sweetmeats as a luxury item and was retailed mainly through confectionery stores. Even today ice cream with a high fat-and-sugar content, especially that classed as "fancy ice cream," is still regarded as a confection and luxury.

The development of the ice cream industry can be most quickly told by listing the approximate dates of some important methods of processing and merchandising.

1777 The New York Gazette carried ice cream advertising.

1811 Dolly Madison served ice cream at the White House.



Courtesy, Dairy Industries Supply Association, Inc.

Fig. 1. From a painting entitled "A Surprise" based on records that Dolly Madison served Ice Cream to her White House guests.

1848 Patents granted on a revolving household type of hand freezer with dasher.
1851 Wholesale production started in Baltimore.
1876 Ice cream soda introduced at Centennial Exposition, Philadelphia.
1892 The Pennsylvania State College established the first course in ice cream making.
1902 The horizontal, circulating brine freezer was invented.
1904 The ice cream cone appeared at the World's Fair, St. Louis.
1906 The spray process of drying milk was invented.
1911 The homogenizing process was applied to evaporated milk.
1913 The continuous freezing process was patented. Although this was essentially the same as the present process, it was not widely used for a number of years.
1920 Ice cream was pretty generally recognized as a protective and essential food.
1920 Packaging machines for ice cream appeared.
1921 "Eskimo Pie" was patented. The first of the coated ice creams and novelty sticks.
1925 Solid CO_2 (dry ice) was used to facilitate delivery of ice cream.
1929-1934 Rapid development and acceptance of continuous (sometimes called "instant") freezers.
1940-1945 Development of "Deep Freeze" units for the home.



Courtesy, Ice Cream Trade Journal.

Fig. 2. The Ice and Salt Freezer quite commonly used in Ice Cream plants in the early part of the twentieth century.

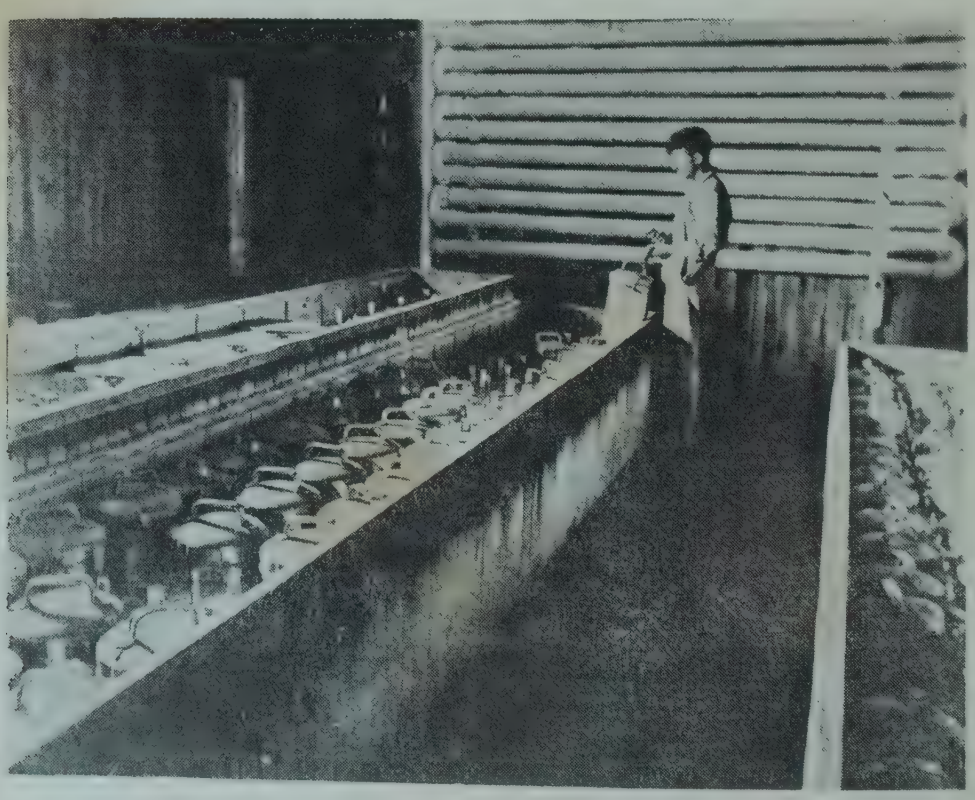
1946 Carry-home packages marketed through grocery stores and Frozen Food stores.

Available records seem to indicate that the ice cream industry grew very slowly until after 1900. Since 1920 when the value of ice cream as a protective and essential food was generally recognized, the growth has been unusually rapid. Table 1 illustrates this point:

TABLE 1. TOTAL GALLONAGE AND YEARLY CONSUMPTION OF ICE CREAM

Year	*Gallonage*	*Per Capita Consumption (gallons)*
1910	95,000,000	1.04
1920	257,820,000	2.46
1930	345,714,000	2.82
1940	318,088,000	2.40
1944	446,889,000	3.22
1946	713,594,000	4.75
1947	629,090,000	4.12
1948	570,060,000	3.80
1949	553,985,000 (estimated)	3.68

Surveys of hotels, restaurants, dining cars, etc., show that ice cream is now served in such establishments more often than all other desserts combined.



Courtesy, Ice Cream Trade Journal

Fig. 3. Brine Tanks used for hardening Ice Cream in the early part of the twentieth century.

Its appearance in take-home packages in grocery stores, also indicates its growing popularity.

Some of the factors contributing to the recent development of the ice cream industry are:

1. The perfection of mechanical refrigeration and its application to the food industry.
2. Improved manufacturing methods and equipment such as the homogenizer, overrun testers, continuous freezers, packaging machines, *etc.*
3. More and better ingredients and more knowledge concerning ice cream making, resulting in a better product.
4. Lower manufacturing costs through mass production.
5. Extensive advertising of the product.
6. A realization of the high food value of ice cream.
7. Changing economic conditions—better wages, more purchasing power, a higher standard of living.

The importance of the ice cream industry is further shown by its relation to the other branches of the dairy industry. Table 2 shows that approximately 5.1 per cent of all milk produced in the United States is utilized by the ice cream industry. Over 40 per cent of the ice cream is made during the early summer months when there is a seasonal increase in milk production. Thus the ice cream industry acts as a balance wheel for the dairy industry in supplying a profitable market for the seasonal increase in production.

Table 2. Utilization of Milk in the U. S. in 1948

Product	*Per Cent of Total Milk Used*	*Product*	*Per Cent of Total Milk Used*
Creamery butter	21.1	Dry milk, cream and malted milk	1.6
Farm butter	5.0	For household use	48.0
Cheese	9.2	Fed to calves	2.6
Condensed & evaporated milk	6.9	Misc. products & waste	0.5
Ice cream	5.1	Total	100.0

The future development of the industry is intimately tied up with the prosperity of the working classes. Good wages and full employment are essential. The product must be sold at a fair price in order to compete successfully with other foods. Since many consumers still regard ice cream as a confection and luxury rather than a staple food, continual educational campaigns emphasizing the food value of ice cream should bring increasing demands for this most desirable product.

CHAPTER II

FOOD VALUE OF ICE CREAM

Ice Cream is America's favorite dessert and it is also a most desirable and nutritious food. It is made largely of cream, milk, milk solids, fruits, and other flavorings, sweetened and blended so as to give these valuable foods a most delicious and eye-appealing form. As a stimulant to lagging appetites it obviously adds much to the comfort and well-being of consumers during the hot weather when energy is apt to be at low ebb. As a "morale" builder it is regarded by dietitians and physicians as one of the best foods to create the psychological well-being so necessary to health and happiness. Its growing popularity as a food rather than a luxury item is indicated by its appearance in grocery stores where it retails at prices which compare favorably with prices of many staple foods.

The food value of ice cream obviously depends upon the food value of the products from which it is made. The milk products which go into the mix contain the same constituents as does whole milk, but in different amounts. For instance, ice cream contains 3 or 4 times as much fat, and about 12 to 16 per cent more protein than does milk. In addition it may



Courtesy, Professor P. S. Lucas, Michigan State College.

Fig. 4. "An old timer" ice and salt freezer, known as the "French Pot," is still in use in some markets.

contain other food products such as fruit, nuts, eggs, and sugar which enhance its nutritive value. However, like milk, it lacks iron and some of the trace minerals.

Calcium content of ice cream. Milk and its products, such as ice cream, are among the richest sources of calcium, phosphorus, and other minerals of vital importance in building good bones and teeth. Recent dietary research shows that large quantities of these products are needed to bring America's health standards above the safety line. Research also indicates that additional amounts of lactose (milk sugar) in a diet favors the assimilation of calcium. Ice cream, which is rich in lactose, should therefore favor the assimilation of greater quantities of the calcium content of the diet which is needed so much by growing children and at least some adults. The calcium and phosphorus content of milk and ice cream are given here in grams per hundred grams of milk and of ice cream.

	Calcium per 100 grams	*Phosphorus per 100 grams*
Milk	0.118 grams	0.093 grams
Ice Cream	0.080 grams	0.060 grams

The daily human requirements of calcium (lime) as recommended by the Committee of Foods and Nutrition, National Research Council, are as follows:

Individual	*Grams Calcium*
Normal adult	0.80
Children (up to 20 years)	1.40
Pregnant mother	1.50
Nursing mother	2.00

The ordinary mixed diet of the average American household provides the following amounts of calcium:

Daily Food Intake	*Grams Calcium*
Regular serving of meat, potato and bread	0.029
Two eggs	0.101
Regular servings of fruits and vegetables	0.158
The above foods total	0.288
One pint of milk adds	0.830
One large serving (1/6 qt.) ice cream	0.170
Total	1.288

This provides a total well above the absolute needs of adults. If children and pregnant mothers take another half pint of milk daily their calcium intake will be abundantly sufficient.

The protein content of ice cream also rates high, both in amount and in quality. The proteins are mostly derived from milk, a small amount from gelatin, and from eggs when eggs are used in the mix. The milk and egg proteins are complete; that is, they contain all the amino acids essential to animal life and are especially important sources of two of these, *viz.*, tryptophane and lysine which are lacking in many plant proteins. They are, therefore, the most perfect proteins known and are almost completely assimilated by the body tissues. They serve as fine supplements to the protein-deficient foods such as potatoes, cereals, bread, etc. Ice cream provides these valuable proteins in a very palatable form. In fact, ice cream is to many individuals the most palatable source of milk proteins.

TABLE 3.—COMPOSITION OF PLAIN ICE CREAM*

Protein	3.9 per cent
Fat	13.0 per cent
Carbohydrates	20.3 per cent
Fuel value per 100 grams	214 calories
Weight of a 100 calorie portion	47 grams

Ice cream is also an excellent source of energy. As has been stated, the fat content of ice cream is three or four times that of milk, and fully half its total solids content is sugar (including lactose, sucrose, *etc.*). The fact that these constituents are almost completely assimilated makes ice cream an especially desirable food for growing children and for persons who need to put on weight. But it can equally well find a place in the diet of persons who need to reduce or who do not wish to gain weight.

Ice Cream in the Reducing Diet. "Add ice cream to your regular diet and increase your weight; take ice cream as part of your regular diet and reduce your weight." Very often one sees this apparently contradictory statement that ice cream is both a fattening food and a food which can be used to advantage in a reducing diet. This paradox clears up when it is understood that a food may be taken as a supplement to a regular diet, or as a substitute for some other food in the diet. Therefore, if ice cream is consumed in fairly large amounts in addition to a diet already high in caloric values, the tendency is for the person to put on weight. However, if ice cream is used as one of the regular foods in a diet combination and proper moderation is practiced regarding the richer desserts, there is no reason why it can not be a part of even a slenderizing diet. A study of comparative caloric values indicates that many other desserts are far higher in calories than is ice cream. As an example, a serving of ice cream ranging in size

* From *Chemistry of Food and Nutrition*, by H. C. Sherman, 1941.

from 1/12 to 1/6 of a quart, provides approximately 96 calories in the smaller serving and 200 in the larger serving, while an ordinary serving of lemon pie contains 450 calories.

Vitamin content of ice cream. Like milk, ice cream is a rich source of many of the essential vitamins, those food accessories without which normal health and growth can not be maintained. A brief description of the better known vitamins may help to emphasize the importance of milk and ice cream in the diet.

Vitamin A—the anti-infective vitamin—is the principal butterfat vitamin. It is most important in building resistance to infection in the respiratory tract, in preventing night blindness, and maintaining general good health, **Ice cream is an excellent source.**

Vitamin B_1, or Thiamin—known also as the anti-neuritic vitamin—stimulates appetite, promotes growth, helps maintain normal motility of the digestive tract, and is largely a preventive of polyneuritis. **Ice cream is a good source.**

Niacin—anti-pellagra factor of the B complex vitamins (B_1, G, and others less well known)—is very important in the prevention and cure of pellagra, and in the maintenance of good health in general. **Ice cream is a fair source.**

Vitamin E—is known as the anti-sterility vitamin since it is concerned with maintaining normal health of the reproductive organs in laboratory animals. Its value in human nutrition is not fully understood. **Ice cream is a fair source.**

Vitamin G—now generally known as Riboflavin—ranks with calcium and vitamin A as necessary for nutritional well-being for young and old alike. It is known also as the youth-promoting vitamin and seems to be a factor in extending the "prime of life." **Ice cream is a good source.**

Vitamin C—the anti-scorbutic factor—is most important in prevention of scurvy. It is not stored in the body. Most fruits contain an abundant supply, especially the citrus varieties. Many kinds of ice cream carry much fruit. These fruits, such as strawberries, pineapple, peaches, oranges, and lemons, in addition to other food values, supply additional amounts of vitamin C. **Fruit ice cream is a fair source.**

Vitamin D—the anti-rachitic or "sunshine" vitamin—prevents rickets in small children and pregnant women by helping to maintain the normal concentrations of calcium and phosphorus in the blood. [illegible]mall amount in ice cream unless the milk products have been fortified with vitamin D.

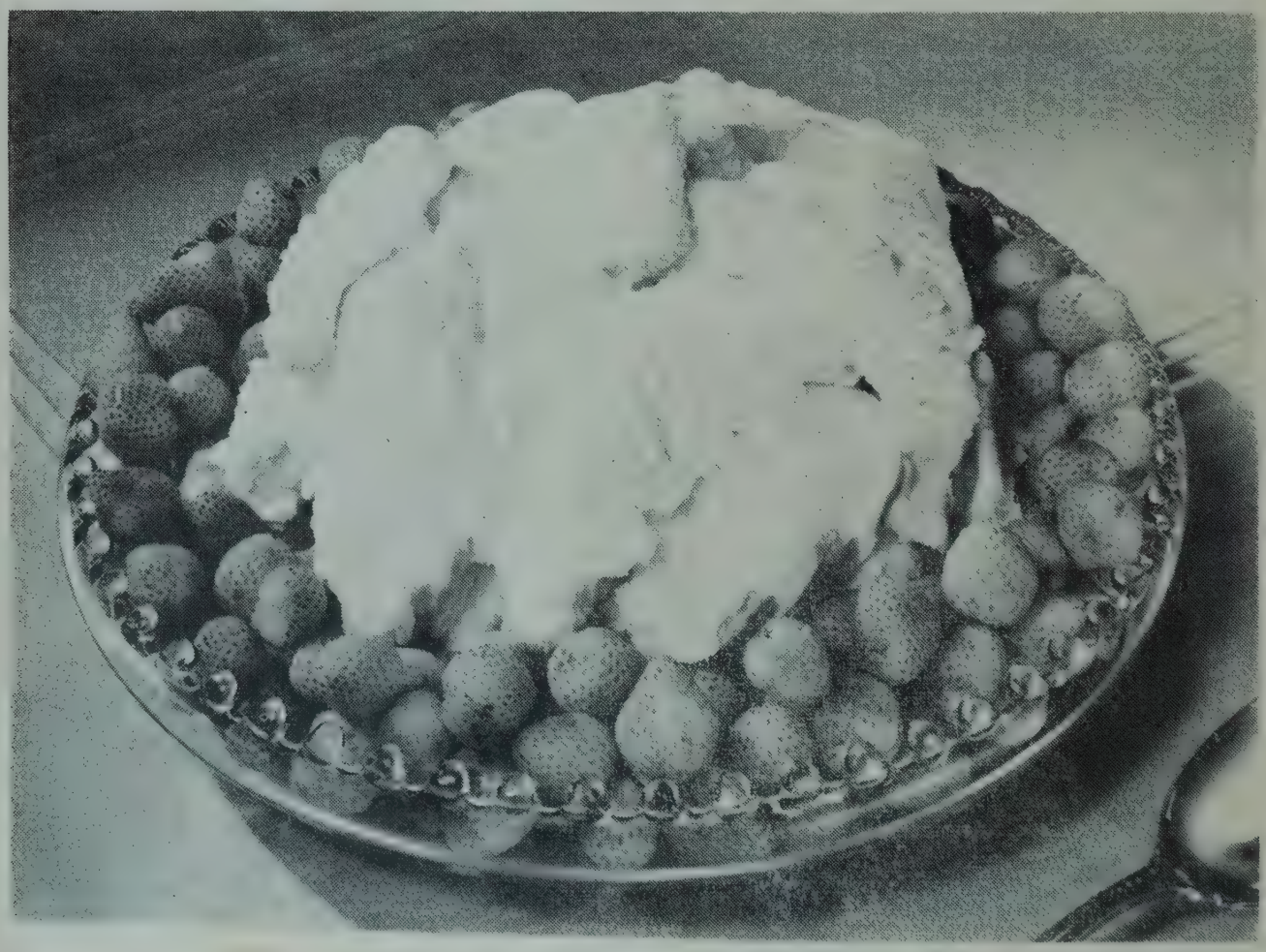
Vitamin K—this important and more recently discovered vitamin has been found necessary for the proper coagulation of the blood. It is now used extensively to prevent bleeding in operations, and from serious wounds, *etc.* There is every reason to assume that this vitamin is found in milk and milk serum solids and therefore will also be found in ice cream.

TABLE 4. NUTRIENT CONTENT OF VANILLA ICE CREAM
100 grams (about 1/6 quart)=206 calories

Nutrient	*Amount*	*Nutrient*	*Amount*
Protein	3.850 gm.	Iron	0.120 mg.
Fat	12.060 gm.	Vitamin A	548 I. U.
Carbohydrate*	21.310 gm.	Thiamin	0.038 mg.
Total Mineral	0.810 gm.	Riboflavin	0.236 mg.
Calcium	0.122 gm.	Niacin	0.098 mg.
Phosphorus	0.105 gm.	Ascorbic Acid	0.000 mg.

* Includes milk sugar (lactose) and sweetenings.

Digestibility and palatability of ice cream. Many experiments show that homogenized milk is more digestible than milk not so treated. This is based



Courtesy, National Dairy Council

Fig. 5. Ice Cream—the Great American Dessert—a taste-tempting food rich in energy, vitamins and other food essentials.

on the fact that the homogenizer has broken the fat globules into very, very minute fat particles which can be more readily acted upon by the digestive juices than can the larger fat globules. The same holds true for the fat in the ice cream mix when it is forced through the homogenizer as is now the practice in most up-to-date commercial ice cream plants. In addition, the high palatability of ice cream stimulates the flow of the digestive juices, a valuable aid to the digestive process. These two factors, together with its smooth velvety texture, and its glistening coolness, make it an ideal food for many invalids suffering from throat afflictions or certain stomach ailments, when other foods do not appeal or can not be tolerated. These qualities together with its value as a morale builder have led hospitals to use ice cream extensively in their menus.

It is safe to say that no other food product contributes so much food value in as attractive and appealing a form, or is so universally liked and distributed as ice cream.

TABLE 5. APPROXIMATE FOOD VALUE OF COMMERCIAL ICE CREAM AND SHERBET.

Usual variations in composition will neither increase nor decrease the values in the table by more than 10 to 15 per cent of the value given.

Product	*Amount*	*Calories*	*Protein grams*	*Calcium grams*	*Phosphorus grams*	*Iron mgm.*	*Vit. A I. U.*	*Thiamin mgm.*	*Riboflavin mgm.*
Vanilla ice cream	one quart	1202	24.0	0.784	0.623	0.85	3288	0.229	1.416
Vanilla ice cream	1/6 qt. one* serving	200*	3.9	0.131	0.104	0.14	548	0.038	0.236
Raspberry Sherbet	one quart	1544	14.0	0.245	0.233	4.63	.....	.....	0.091
Raspberry Sherbet	1/6 qt. one* serving	257*	2.3	0.041	0.039	0.77	.....	.....	0.015

*The amount accepted as one serving by most dietitians and physicians.

TABLE 6. THE FOOD VALUE OF ICE CREAM
and of foods often used similarly or served with ice cream

Food	*Measure weight*	*Calories*	*Protein gm.*	*Calcium gm.*	*Iron gm.*	*Vit. A I.U.*	*Thiamin mg.*	*Riboflav. mg.*	*Ascorbic Acid mg.*
Vanilla Ice Cream	1/6 qt. 100 gm.	206	3.8	0.122	0.12	548	0.038	0.236	0
Angel Cake	1/10 10″ cake 111 gm.	300	9.0	0.006	0.15	.....	.....	0.129	0
Sugar Cookies	2 cookies 28 gm.	100	1.4	0.004	0.10	200	0.012	0.081	0
Apple Pie	1/8 9″ pie 100 gm.	230	2.3	0.009	0.46	115	0.020	0.021	1
Baked Apple (2 T. sugar)	1 medium 158 gm.	260	0.5	0.010	0.45	90	0.034	0.038	2
Chocolate Cup Cake	2¾″ dia. 51 gm.	200	2.3	0.013	0.30	350	0.018	0.036	0
Brown Betty	½ cup 145 gm.	250	2.3	0.012	0.40	450	0.018	0.036	2
Rice Pudding (milk & eggs)	½ cup 130 gm.	135	5.8	0.078	0.90	450	0.042	0.189	0
Custard	½ cup 111 gm.	130	5.5	0.127	0.80	470	0.054	0.270	0
Chocolate Pudding (milk)	½ cup 108 gm.	200	5.0	0.143	0.45	215	0.042	0.252	1
Fruit Cup	½ cup 80 gm.	75	0.7	0.011	0.32	85	0.066	0.027	23
Lemon Sherbet (milk)	½ cup 131 gm.	200	2.5	0.099	0.32	150	0.036	0.162	12
Milk	1 glass 244 gm.	168	8.5	0.290	0.08	375	0.090	0.410	4

CHAPTER III

CLASSIFICATION OF ICE CREAM, SHERBETS, AND ICES

Classification of ice cream, sherbets and ices has been attempted by various authors of ice cream text books and by leading authorities in the industry from time to time over a period of years, but as yet no standard classification has been adopted. The innumerable variations in the composition of ice cream, in the ingredients and the methods of using them, and in the forms in which the finished product is marketed are the source of much confusion in any attempt to make specific rules for definite classes of ice creams. However, there is somewhat unanimous agreement that all frozen dairy desserts can be classed under the groups given here.

Definition of Ice Cream. The general term Ice Cream is commonly used to denote frozen food made from such a mixture of dairy products as will give the desired percentage of butterfat and nonfat milk solids, together with sugar, flavoring, coloring, and stabilizer, and with or without eggs, fruit, nuts, *etc.,* and usually made smooth by whipping or stirring during the freezing process.

CLASSIFICATION

1. **Plain Ice Cream:** an ice cream in which the total amount of the color and flavoring ingredients is less than 5 per cent of the volume of the unfrozen ice cream. Examples are vanilla, coffee, maple, and caramel ice cream.
2. **Bisque:** ice cream containing appropriate flavorings, and particles of either grapenuts, macaroons, ginger snaps, sponge cake, or other bakery products.
3. **Candy or Confection:** ice cream with appropriate flavorings plus particles of candy, such as peppermint stick, buttercrunch, chocolate chip.
4. **Chocolate:** ice cream flavored with cocoa or chocolate.
5. **Fruit:** ice cream containing fruit, with or without additional fruit flavoring or color. The fruit such as strawberry, apricot, pineapple, *etc.,* may be fresh, frozen-pack, canned or preserved.
6. **Nut:** ice cream containing nut meats, almonds, pistachio, walnuts, *etc.,* with or without additional flavoring or color.
7. **Puddings:** ice cream containing a generous amount of mixed fruits, nut meats, and raisins, with or without liquor, spices, or eggs. Examples: Nesselrode and plum puddings.

8. **Custard:** ice cream cooked to a custard before freezing. It contains a generous amount of eggs, with additional flavoring and color.

9. **Parfait:** a frozen custard of high fat content.

10. **Mousse:** whipped cream, plus sugar, color, and flavoring, and frozen without further agitation. Sometimes condensed milk is added to give better consistency.

11. **Rippled ice cream:** a plain vanilla ice cream combined with a syrup such as chocolate, butterscotch, *etc.*, so as to produce a marbled effect in the hardened ice cream.

12. **Rainbow ice cream:** a product made by carefully mixing six or more different colored ice creams as they are drawn from the freezers, to give a marbled or rainbow colored effect when the product is hardened.

13. **Gelatin cube ice cream:** an ice cream in which colored, fruit-flavored gelatin, cut into small cubes, is used in place of fruits to give color and flavor and a characteristic chewiness.

14. **Ice Milk:** milk with a fat content of about 4 per cent and with 12 to 15 per cent serum solids, sweetened, flavored, and frozen like ice cream.

15. **Ices:** made of fruit juice, sugar, and stabilizer, with or without additional fruit acid, color, flavoring, or water, and frozen to the consistency of ice cream.

16. **Frappé:** an ice made from a mixture of fruit juices and frozen to a slushy consistency; to be served as a drink.

17. **Punch:** a frappé made of mixed fruit juices with or without fruit pulp or additional sugar, water, and spices. Liquors may be used to replace some or all of the fruit juices.

18. **Granite:** water ice frozen with very little agitation.

19. **Sherbet:** made of fruit juices, sugar, stabilizer, and milk. It is similar to an ice except that milk, either whole, skim, condensed, or powdered, or ice cream mix, is used in place of all or part of the water in an ice.

20. **Soufflé:** a sherbet containing egg yolk or whole eggs.

21. **Lacto:** made from buttermilk or cultured sour milk, eggs, fruit juices, and sugar, and frozen like ices and sherbets.

22. **Fruit Salad:** mixed fruits, in large pieces, in combination with a mix-

ture of whipped cream and mayonnaise, and frozen to be served as a salad. (Mayonnaise may be omitted if desired.)

23. **Fancy Molded Ice Cream includes ice creams (and ices and sherbets)** molded in fancy shapes and composed either of one color and flavor of ice cream or of a combination of colors and flavors, or specially decorated. This group includes:
    a. Brick ice cream in one, two, or more layers, or with fancy centers.
    b. Sliced brick with decorative stenciled designs (individual size).
    c. Cakes, pies, melon molds, log rolls, sultana rolls, *etc.*
    d. Cake roll—layered ice cream on moist cake, rolled like a jelly roll.
    e. Individual or larger molds representing fruits, flowers, animals and other objects, emblems, and designs.
    f. Ice cream waffles and tarts.
    g. Spumoni: a combination of vanilla ice cream, chocolate ice cream or mousse, cherries, and tutti frutti ice cream or whipped cream combined with fruits, arranged in a spumoni cup, and hardened to serve. Sometimes classed as a parfait.
    h. Aufait: two or more layers of ice cream with pectinized fruits or preserves spread thinly between the layers; or the fruits may be stirred gently into the ice cream as it comes from the freezer, to give a marbled appearance.

24. **Novelties:** A novelty ice cream or frozen confection is a specially shaped and usually a low-priced package containing an individual serving whose main appeal consists in its shape, size, color, or convenience for eating. Listed as novelty items are:
    a. Eskimo pies, and candy or chocolate-coated ice cream bars with or without sticks.
    b. Candy or chocolate-coated ice milk bars, with or without sticks.
    c. Ice cream sandwiches—slabs of ice cream pressed between cookies, and wrapped in wax paper and hardened.
    d. Popsicles, fudgsicles, and other ice-like mixtures frozen on sticks.
    e. "Soft" ice cream and "Soft" ice milk (these products are sold as drawn from the freezer without hardening).
    f. Frosted malted milk—made from milk containing from 4 to 8 per cent butterfat and about 10 per cent nonfat milk solids, sugar, and stabilizer, and flavored with malted milk powder and chocolate. Like "Soft" ice creams it is served from the freezer without hardening.

REGULATORY TYPE OF CLASSIFICATION

For regulatory purposes, legislative and administrative officials are finding it desirable to establish a different type of classification. Any classification based upon methods of processing (such as "agitation while freezing"), or upon the kind of ingredients (such as bakery goods), or upon shape is without much meaning from a regulatory enforcement point of view. Some regulatory officials have found it convenient to use a classification based on the concentration of some of the constituents, *i.e.,* milk fat, serum solids, egg yolk solids, and stabilizer. Table 7 suggests the form of such a classification arranged in the order of decreasing richness of product. It is easy to interpret and should be simpler to enforce, includes all products that are generally prepared by ice cream manufacturers, and broad enough to include almost any combinations that may become popular. Its chief disadvantage is the fact that it does not suggest names for particular combinations of either ingredients, processing, or shapes.

The term "frozen desserts" in this classification includes the frozen custards, ice cream (either plain or composite), ice milk, sherbert, and ices.

Frozen custard represents the more expensive type of ice cream, including such products as parfait. It may be sold as fancy molded, a novelty (such as candy coated), "Soft" frozen custard, or bulk frozen custard.

Plain ice cream, defined on page 13, includes the wide range of commercial ice creams even to the high fat ice creams and those containing small amounts of egg yolk solids. A mousse containing no fruit, nuts, *etc.,* would be included as a plain ice cream. These products may be either fancy molded, novelties, or bulk ice cream.

Composite ice cream is either ice cream in which the total volume of coloring and flavoring material is more than 5 per cent of the volume of the unfrozen product, or ice cream containing visible particles of such products as cocoa, fruit, nut meats, candy, bakery products, *etc.* It may have a high fat content, contain small amounts of egg yolk solids, and be either fancy molded, novelties, or bulk composite ice cream. It includes such ice creams as chocolate, fruit, nut, candy, bisque, and puddings.

Ice milk, defined on page 14, may be either fancy molded, novelties, or bulk ice milk.

Sherbet, defined on page 14, may be either fancy molded, novelties, or bulk sherbet and includes such products as Lacto.

Ices, defined on page 14, may be either fancy molded, novelties, or bulk ices. This group includes such products as punch, granite, and popsicles.

Definitions for fancy molded and novelties can be found on page 15.

The term "bulk" refers to ice cream such as is commonly purchased by retailers for re-packaging.

TABLE 7. CLASSIFICATION OF FROZEN DESSERTS BASED UPON THE CONCENTRATION OF CERTAIN CONSTITUENTS

Group	*Distinguishing characteristics*	*Suggested regulatory limitations*
I Frozen Custard	High in egg yolk solids which are cooked to a custard before freezing Medium to high in milk fat Medium to high in serum solids With or without fruit, nuts, bakery products, candy, liquor, or spices With or without agitation while freezing	Not more than: 0.5% edible stabilizer 100,000 bacteria per gram Negative coli test Not less than: The equivalent of 60 egg yolks per 90 lb. of mix 10.0% milk fat 18.5% total milk solids 1.6 lb. food solids per gal. of finished product
II Plain Ice Cream	Medium to high in milk fat Medium to high in serum solids With or without egg products With or without agitation while freezing Without visible particles of flavoring material With the total volume of color and flavor less than 5% of the volume of the unfrozen ice cream	Not more than: 0.5% edible stabilizer 100,000 bacteria per gram Negative coli test Not less than: 10.0% milk fat 18.5% total milk solids 1.6 lb. food solids per gal. of finished product
III Composite Ice Cream	Medium to high in milk fat Medium to high in serum solids With or without egg products With or without agitation while freezing With the total volume of color and flavor material more than 5% of the volume of the unfrozen ice cream or with visible particles of such products as cocoa, fruit, nut meats, candy, bakery products, liquor, or spices.	Not more than: 0.5% edible stabilizer 100,000 bacteria per gram Negative coli test Not less than: 8.0% milk fat 16.5% total milk solids 1.6 lb. food solids per gal. of finished product
IV Ice Milk	Low in milk fat Low in serum solids With or without egg products, chocolate, fruit, nut meats, candy, liquor, or spices With or without agitation while freezing	Not more than: 0.5% edible stabilizer 100,000 bacteria per gram Negative coli test Not less than: 3.3% milk fat 14.0% total milk solids 1.3 lb. food solids per gal. of finished product
V Sherbet	Tart flavor Low in total milk solids With or without egg products, chocolate, fruit, nut meats, candy, bakery products, liquor, or spices With or without agitation while freezing	Not more than: 50,000 bacteria per gram Negative coli test Not less than: 0.35% acidity calculated as fruit acid 4.0% total milk solids 1.8 lb. food solids per gal. of finished product
VI Ice	Tart flavor. No milk solids With or without egg products, chocolate, fruit, nut meats, candy, liquor, or spices With or without agitation while freezing	Not more than: No milk solids 50,000 bacteria per gram Negative coli test

CHAPTER IV

COMPOSITION AND PROPERTIES

THE CONSTITUENTS OF THE INGREDIENTS IN THE MIX DETERMINE ITS COMPOSITION.

A frozen dessert is composed of a mixture of food materials such as fruit, cream, sugar, *etc.*, which are usually called the ingredients. The wide variety of ingredients which may be used to produce different types of frozen desserts is apparent from the classifications discussed in Chapter 3. Furthermore, any one type of frozen dessert, such as ice cream, may be made by combining the ingredients in any one of several different proportions. However, the effect of these ingredients upon the finished product is due to the constituents of the ingredients, and these constituents become the constituents of the finished product. Therefore the composition of a frozen dessert is usually expressed as percentages of its constituents; *i.e.*, percentages of milk fat, serum solids, sufect (see page 19), egg yolk solids, stabilizer, and total solids.

TABLE 8. APPROXIMATE COMPOSITION OF USUAL COMMERCIAL ICE CREAMS

Milk Fat *per cent*	Serum solids *per cent*	Sufect *per cent*	Stabilizer *per cent*	Egg yolk solids *per cent*
8	11 - 12	12 - 15	0.30 - 0.50	0 - 0.50
10	10 - 11	11 - 15	0.30 - 0.50	0 - 0.50
12	9 - 10	11 - 15	0.25 - 0.50	0 - 0.50
14	8 - 9	12 - 15.5	0.20 - 0.40	0 - 0.50
16	7 - 8	12 - 15.5	0.20 - 0.40	.....
18	6 - 7	13 - 16	0 - 0.25	.....
20	5 - 6	14 - 16.5	0 - 0.25	.....

In ice cream, the percentage of milk fat varies more than any other constituent. The milk fat content may vary from 8 to 24 per cent, depending upon such factors as state or city requirements, grade, price, competition, *etc.* As the fat content of ice cream is increased, the serum solids must be decreased so as to avoid "sandiness" (*i.e.*, the crystallization of milk sugar or lactose in the finished ice cream). Table 8 suggests compositions which avoid sandiness and permit recognition of particular local preferences as to sugar content, fat content, *etc.* These local preferences and the quality of the ingredients, as well as the technique of manufacture, are fully as important as the composition in determining the best ice cream for that locality.

Characteristics of a Satisfactory Composition. A satisfactory composition produces an ice cream having the desired combination of cost, food value, flavor, body and texture, cooling effect, color scheme, viscosity, whipping ability, and freezing point. Some of these characteristics are fairly closely associated. For example, a lower freezing point increases the cooling effect

and tends toward a more pronounced flavor. Although the methods of processing and freezing influence these characteristics of ice cream, the effect of the constituents supplied by the ingredients is more important. Therefore the role of each constituent (fat, serum solids, *etc.*) should be understood.

THE ROLE OF THE CONSTITUENTS OF ICE CREAM

Milk Fat, the most important constituent of ice cream, is high in food value and high in cost. Its influence on cost is shown by the fact that the cost of ice cream is raised about five cents a gallon for each per cent of increase in fat when the fat costs one dollar per pound. It contributes a characteristic richness and mellowness to produce the full, rich, creamy flavor which ice cream should have. Thus the flavor is improved by additional increments of fat until about 16 per cent is reached. However, the fat must be of fine flavor for if it is even slightly off-flavored the defect will be more noticeable in rich ice cream. The fat also contributes to the body and melting resistance of ice cream while producing a smoothness of texture that is difficult to obtain by any other means. Since fat gives stability to the ice cream, less stabilizer is necessary in higher fat mixes. Although the viscosity of the mix increases with the fat content, the fat does impair the whipping ability. Since milk fat is in suspension, it has no effect on the freezing point. A satisfactory fat content, as indicated by the experience of numerous manufacturers, is 12 per cent or slightly above.

Serum Solids are the solids of skim milk. They include a small amount of fat, the proteins, the milk sugar, and the mineral matter. They are high in food value and inexpensive, but they add very little to flavor, except indirectly by improving the body and texture. The milk sugar adds to the sweet taste largely produced by added sugars, and the minerals tend to carry a slightly salty taste which rounds out the flavor of the finished ice cream. The proteins in the serum solids help to make the ice cream more compact and smooth and thus tend to prevent a weak body and coarse texture. Therefore, as much serum solids should be added as possible without getting into the danger zone for sandiness. Too high concentrations, however, may impart an objectionable condensed milk flavor. Serum solids increase viscosity and resistance to melting but lower the freezing point. Usual variations in concentration of the serum solids have no pronounced effect on whipping ability, but variations in their quality do have an important influence on whipping ability.

Sufect, as here used, means the sweetening effect of added sugars expressed as the weight of sucrose necessary to give an equivalent sweet taste. For many years sucrose (cane or beet sugar) was the only sweetening agent added to ice cream; consequently it has been used as a standard in compar-

ing the sufect (sweetening effect) of other sugars. However, during the last thirty years there has been an increasing tendency to obtain the desired sufect by blending sucrose with other sugars. This tendency has been due in part to insufficient supplies of sucrose, in part to the gradual improvement in quality of the more economically priced other sugars, and in part to a desire to increase the total solids of some ice creams without exceeding the limit of desirable sweetness of flavor.

It is now accepted that the desired sufect can be obtained only by using some sucrose in the blend. The percentage of the sufect which can be obtained from other sources is influenced mainly by (1) the desired concentration of sufect in the mix, (2) the total solids content of the mix, (3) the effect on the properties of the mix, such as freezing point, viscosity, and whipping ability, and (4) the concentration in the sufect source of substances other than sufect; for example, the undesired flavor of honey, or the undesired color of molasses.

The main function of sufect is to increase the acceptance of the product, not only by making it sweeter but more especially by enhancing the pleasing creamy flavor and the desired delicate true fruit flavors. Lack of sufect produces a flat taste while too much tends to overshadow desirable flavors. The sufect varies from 12 to 20 per cent, while 14 to 16 per cent seems most desirable. The sugars used as a source of sufect increase the viscosity and the total solids concentration of the mix. This improves the body and texture of the ice cream provided the total solids content does not exceed 42 per cent or the sufect content does not exceed 16 per cent. Above these limits, the ice cream tends to become soggy and sticky. These sugars, being in solution, depress the freezing point of the mix. This results in slower freezing and requires a lower temperature for proper hardening. In addition to their effect on the quality of the ice cream, they are usually the cheapest source of total solids in the mix.

Egg Yolk Solids are high in food value but greatly increase the cost of ice cream. They impart a characteristic delicate flavor which aids in obtaining a desirable blending of other flavors, but even slight off-flavors in egg products are easily noticeable in the ice cream.

They have a pronounced effect in improving the body and texture, have almost no effect on the freezing point, and increase the viscosity. Egg yolk solids, regardless of their source, improve whipping ability, presumably due to lecithin existing as a lecithin-protein complex; and are especially desirable in mixes of low total solids concentration and in mixes where the fat is obtained from such ingredients as butter, butter oil, etc.

Stabilizers are used to prevent the formation of objectionable large ice crystals in ice cream and are used in such small amounts as to have a neg-

Table 9. Sources of Sufect (Sweetening Effect) in Ice Cream

Approximate data to serve as a guide in calculating mixes.

Commercial Product	*Physical Appearance*	*Type of Sugar*	*Per cent Sufect Content*	*Pounds to equal 1.0 lb. of Sucrose*	*Per cent of total Sufect it can supply*[1]	*Per cent Total Solids*	*Weight per Gallon lb.*
Sugar Granulated sugar (Cane or Beet)	dry crystals	Sucrose	100	1.00	100	100	7.5
Dextrose Cerelose Dextrose hydrate Corn sugar	dry crystals	Glucose	80	1.25	35	92	
Corn syrup solids Frodex, Dri-Sweet, Clintose, etc.	dry crystals	Dextrose & Maltose	47	2.10	35	96.5	
Liquid Sugar[2]	liquid	Sucrose	67	1.50	100	67.0	11.1
Invert sugar syrup[3]	liquid	Dextrose & Levulose	95	1.05	33	74.0	11.5
Corn Syrup[4] Sweetose[4]	liquid	Dextrose & Maltose	67	1.50	35	83.0	9.5
Honey	liquid	Dextrose Levulose Sucrose	75	1.40	30[5]	82.0	

(1) The recommended maximum amount. For example: dextrose should supply no more than 35% of all the sufect in the mix.
(2) The usual liquid sugar (67%) employed by ice cream makers.
(3) Assuming 95% complete inversion with a 74% sucrose solution.
(4) The usual commercial syrup of 43° Baumé.
(5) Assuming a mild flavored honey, less if strong flavored.

ligible influence on food value and flavor. They are of two general types, (1) the gelatin type of stabilizers which come from animal sources, such as calf skin, pork skin, bones, *etc.,* and supply certain desirable amino acids; and (2) the vegetable stabilizers, such as sodium alginate, Irish moss, agar agar, and such other gums as tragacanth, karaya, oat gum, *etc.* All stabilizers have a high water-holding capacity effective in smoothening the texture and giving body to the finished product. Thus their effect on flavor is indirect. They increase viscosity, have no effect on the freezing point, and with a few exceptions tend to limit whipping ability. Their most important function is to prevent coarsening of texture under temperature fluctuations in retail cabinets. The amount of stabilizer to use varies with its properties and with the solids content of the mix.

Total Solids replace water in the mix, and thereby increase the nutritive value and viscosity, and improve the body and texture of the ice cream. This is especially true when the increase in total solids is due to added dextrine (pro-sugars), sweet cream buttermilk solids or eggs. Egg yolk solids, like sweet cream buttermilk solids, increase the whipping ability and shorten the freezing time. Increasing the concentration of total solids decreases the amount of frozen water and frequently permits a higher overrun while maintaining the minimum of 1.6 pounds of food solids per gallon of ice cream. During hot weather a disadvantage might be that this increase in calorie content somewhat reduces the cooling effect of the ice cream. A heavy, soggy product results when the total solids content is too high, usually when above 40 to 42 per cent.

Ordinary table salt is sometimes used in ice cream. This is usually unnecessary except in special flavors such as custards and nut ice creams. Some believe that a small amount of salt, less than 0.1 per cent improves the flavor of the ice cream. In any case, a salty flavor should be avoided.

Flavor is generally considered the most important characteristic of ice cream. It is easily confused with taste which includes the "feel sensation" of body and texture as well as the true flavor. The flavor of ice cream is the result of blending the flavors of all the ingredients, some of which may not be sufficiently pronounced to be recognizable, although each actually contributes to the final effect. This makes it difficult to forecast the effect of a certain ingredient upon the flavor of the ice cream. Furthermore the desirability of a particular flavor, or more properly "blend of flavors," depends upon the consumer or individual doing the tasting. This is particularly true of the average consuming public and frequently explains why a certain blend of flavors is less desirable at some times than at others.

Flavor has two important characteristics: type and intensity. Flavors that are delicate and mild are easily blended and do not tend to become

tiresome even when very intense, while the harsh type of flavors soon become tiresome even in low concentrations. As a general rule, therefore, delicate flavors are preferable to harsh ones, but in any case the intensity of the flavor should be only strong enough to be easily recognized and delicately pleasing to taste.

THE BALANCED MIX

A balanced mix is one in which the proportions of the constituents and ingredients is such as will produce a fine and generally satisfactory ice cream—an ice cream in which the defects, if there still are any, can not be further corrected by any change in the composition or ingredients of the mix.

Defects such as rancid flavor, feed flavor, or uneven color can not be corrected by changing the concentration of the constituents. Therefore, they do not indicate a poorly balanced mix. However, other defects, such as; (1) "lacks flavoring," *i.e.,* insufficient concentration of flavoring, (2) "lacks richness,"—insufficient concentration of fat, (3) "sandiness"—too high concentration of serum solids, or (4) "weak body," *i.e.,* low total solids or low stabilizer, may be corrected by changing the composition of the mix. These defects do, therefore, indicate that the mix is incorrectly balanced.

Conditions which limit the Balancing of a Mix—It should, however, be remembered that a mix is balanced to give desirable results under certain limited conditions of processing and handling or even of handling the finished ice cream. For example, a mix may be properly balanced for a finished ice cream that is to have a rapid turnover, but would cause sandiness if the ice cream were to be stored for any length of time. Another mix may be properly balanced for freezing in a batch freezer but not in a continuous freezer. A mix may also be thrown out of balance by changing the source of the constituents. For example, if the fat in the mix is obtained from butter instead of from sweet cream, the mix may need the addition of egg yolk solids to improve its whipping ability and to give it the proper balance, but if made with sweet cream the egg yolk solids would not be necessary. A knowledge of the role of each constituent (pages 19 to 23 and Table 9), together with the outline of the advantages and limitations of the constituents, should be helpful in selecting a desired composition and in properly balancing a mix. Usually an ice cream mix that is properly balanced for average commercial conditions will have (1) between 36 and 42 per cent total solids and (2) between 20 and 26 per cent total milk solids (obtained by adding the percentage fat and the percentage serum solids). This does not apply to a mix for ice milk, sherbet, or ice. Furthermore, there has been a tendency to improve the nutritive value of ice cream by increasing the concentration of serum solids and reducing the fat, sugar and flavor

concentrations. Calculations for balancing mixes are given in Chapter VIII.

In the foregoing discussion of the constituents of the ice cream mix, their limitations as well as their advantages and beneficial properties have been pointed out. For easy references these advantages and limitations are summarized in the following outline taken in part from *Theory and Practice of Ice Cream Making* by Dr. H. H. Sommer.

ADVANTAGES AND LIMITATIONS OF THE VARIOUS ICE CREAM CONSTITUENTS

I. Milk fat
   - A. Advantages: (1) increases the richness of the flavor, (2) produces a characteristic smooth texture, (3) helps give body to the ice cream.
   - B. Limitations: (1) cost, (2) fat slightly hinders rather than improves whipping, (3) high fat content may limit the amount of ice cream consumed, (4) high caloric value.

II. Serum solids
   - A. Advantages: (1) improve the texture, (2) help to give body, (3) a higher overrun without snowy or flaky texture, (4) a comparatively cheap source of solids.
   - B. Limitations: (1) a high percentage causes "sandiness," (2) the "condensed milk" flavor may be objectionable.

III. Sufect
   - A. Advantages: (1) usually is the cheapest source of solids, (2) improves the texture, (3) enhances the flavor.
   - B. Limitations: (1) excessive sweetness, (2) lowers whipping ability, (3) longer freezing time required and the ice cream requires a lower temperature for proper hardening.

IV. Stabilizers
   - A. Advantages: (1) very effective in smoothening the texture, (2) very effective in giving body to the product.
   - B. Limitations: (1) excess body and melting resistance.

V. Egg yolk solids
   - A. Advantages: (1) very effective in improving whipping ability, (2) produces a smoother texture. (3) flavor.

B. Limitations: (1) excessive amounts may produce "foaminess on melting," (2) egg flavor not relished by some consumers, (3) cost.

VI. Total solids

A. Advantages: (1) smoother texture, (2) better body, (3) more nutritious, (4) ice cream not as cold.

B. Limitations: (1) heavy, soggy or pasty body, (2) cooling effect not high enough.

VII. Flavor

A. Advantages: (1) increases acceptability.

B. Limitations: (1) harsh flavors less desirable (2) intense flavors quickly satisfy desire.

VIII. Color

A. Advantages: (1) improves attractiveness, (2) aids in identifying flavor.

IMPORTANT PROPERTIES

Viscosity or resistance to flow, has been considered an important property of the ice cream mix, and a certain amount of it seems essential for proper whipping and for retention of air. The viscosity of a mix is affected by:

1. Composition. Viscosity is influenced more by the fat and the stabilizer than by the other constituents.

2. Kind and quality of ingredients. Those carrying the fat are especially important. Also, heat, neutralizers, and salts (such as calcium, sodium, citrates, *etc.,*) greatly affect the viscosity due to their effect on the casein and other proteins.

3. Processing and handling of the mix. The steps in processing which have the greatest effect are pasteurization, homogenization, and aging.

4. Concentration (*i.e.,* total solids content).

5. Temperature.

Although much has been written about the causes and effects of viscosity, there has been no final answer to the questions: how much is desirable; and how can it be accurately measured? A high viscosity was believed essential at one time, but for fast freezing (rapid whipping) in modern equipment a lower viscosity seems desirable. In general, as the viscosity increases, the resistance to melting and the smoothness of body increases, but the rate of whipping decreases. Viscosity is now considered a phenomenon that frequently accompanies rather than causes good whipping, body and texture. Therefore, the mix should be properly balanced (in regard to

composition, concentration, and quality of ingredients) and then properly processed to produce the desired whipping ability, body, and texture. Under these conditions a desirable viscosity is assured.

High whipping ability describes the ability to whip rapidly to a high overrun. It is now definitely known that the differences in whipping ability can not be explained on the basis of viscosity. The present hypothesis is that whipping ability is based on tensile strength and strength of the lamellae or walls around the air cells. Whipping ability is improved by high processing temperatures, proper homogenization, and aging the mix for 2 to 4 hours.

Smaller fat globules and less clumping give increased whipping ability. Mixes made with butter, butter oil, or frozen cream have a less satisfactory dispersion of fat and poorer whipping ability. Egg yolk solids, regardless of their source, and fresh cream buttermilk solids improve whipping ability, presumably due to lecithin existing as a lecithin-protein complex. Emulsifiers, which are described later, also improve whipping ability. Usual variations in concentration of serum solids have no pronounced effect on whipping ability, but qualitative variations in the serum solids are important. Sugar decreases the whipping ability except when added after homogenizing and then it increases whipping ability. Finally, the construction and operation of the freezer itself determine whether the maximum whipping ability of a given mix is obtained.

CHAPTER V

ICE CREAM INGREDIENTS*

Essentials for the manufacture of high quality ice cream are good ingredients mixed and balanced so as to produce a satisfactory composition, together with intelligent processing, freezing, and hardening of the product. All of these factors are important and should be carefully controlled by the ice cream maker.

The selection of good ingredients is, without doubt, the most important factor in successful ice cream manufacture. A clean, fresh, creamy flavor in ice cream can be secured only by the use of products which have been carefully produced and handled. In general, the more concentrated the dairy product and the longer it is held in storage, the less desirable is the flavor imparted to the ice cream.

MILK PRODUCTS USED IN ICE CREAM

Both the butterfat and the serum solids of the milk products used in the mix contribute to the flavor of the ice cream. The butterfat is more important in this respect because the full, rich, and creamy flavor which ice cream should have comes mostly from the butterfat of the mix. The serum solids, on the other hand, have a more indirect effect on flavor. The proteins improve the body and texture and tend to prevent a weak body and coarse texture. The milk sugar adds to the sweet taste largely produced by the added sugars, and the milk salts tend to carry a slightly salty taste which rounds out the flavor of the finished ice cream.

Whole milk is very desirable as a source of fat as well as of serum solids. Only milk of clean flavor and odor, with a low acidity of 0.2 per cent or less, should be used. A combination of milk and sweet cream is probably the best source of fat for ice cream, but cream and skim milk are practically as satisfactory. Fresh whole milk is seldom used because in many markets it is too expensive a source of fat and serum solids.

Fresh sweet cream is the most desirable concentrated source of butterfat for use in the mix. Other concentrated milk products do not impart the same clean, rich, creamy flavor that is carried by a good quality sweet cream. Cream containing 40 per cent fat should not exceed 0.15 per cent acidity and should be free from off-flavors and odors. A butterfat test should be made on each purchase so that the buyer has the assurance that he is receiving the full amount of fat for which he pays. However, sweet cream is

* Flavoring and Stabilizers are discussed in separate chapters.

relatively expensive as a source of fat, fluctuates considerably in quality and price, and has the added disadvantage of being difficult to secure in good quality at certain seasons of the year on some markets.

Frozen cream is stored by many companies during the months of surplus and low price. In storing frozen cream only the very best fresh cream should be used. It should be pasteurized at 165° to 175° F. for 15 minutes to inhibit the development of off-flavors. Neither the milk nor the cream should come in contact with exposed iron or copper, as may occur when the tin has worn off separator parts or utensils, or when bronze fittings or bronze pumps are used. Copper, iron, and bronze from these sources dissolve in the cream, producing a tallowy and metallic flavor during storage of the frozen cream. Storage rooms should be about 10°F. below zero and the cream should be held no longer than six months. While the storing of frozen cream is ordinarily economical, the flavor of such cream after storage is never quite equal to that of good fresh cream. Off-flavors likely to develop in frozen cream are: rancid, fishy, oily, and tallowy flavors. Local regulations may or may not permit the use of cream containing added neutralizers and antioxidants.

When storing cream for use in ice cream, the addition before freezing of 10 per cent by weight of cane sugar is desirable. This cream retains its flavor better, melts more quickly and with less fat separation, and produces a mix with higher whipping ability. However, the addition of sugar ties up additional capital in stored sugar. Moreover, if such cream happens to develop off-flavors there is increased difficulty in finding an outlet for it.

Plastic cream is used to some extent as a source of fat for ice cream. Plastic cream is essentially a very rich cream (80 per cent fat) and is similar to butter in consistency at ordinary temperatures. It is stored and handled commercially like butter.

Unsalted butter (sweet butter) is next to sweet cream in importance as a source of fat. The advantages of butter are that it is a comparatively cheap source of fat, can be transported at low cost, can be stored for months with little deterioration in quality, and is nearly always available in fairly uniform quality. If the butter is of good quality, from 50 to 75 per cent of the fat of the mix can be secured from this source. The unsalted butter should be of a grade that will score 92 or higher and preferably should be made from sweet cream. Such off-flavors as ripened cream, neutralizer, stale, rancid, and tallowy, which are found in butter of low quality, will carry over directly into the mix.

Butter oil is a relatively new source of fat for the ice cream mix. Its quality depends on the quality of the butter or the cream from which it was

made. It is convenient and under proper storage conditions will keep better than butter.

The milk products (with the exception of butter oil) which are used primarily as sources of fat also contribute serum solids as shown in table 12.

Fresh skim milk should be used in the mix whenever available at reasonable prices, because it is a cheap source of serum solids. It should have a low acidity and a clean flavor. A 40-quart can of skim milk will contain about 7.5 lb. of serum solids. Skim milk when purchased should be bought on the basis of a definite serum solids content in order to guard against dilution with water.

When water is used in place of skim milk a larger proportion of condensed or powdered milk is necessary in order to supply the needed serum solids. Unless the product is of exceptional quality, this practice usually results in a slightly cooked or "serum solids" off-flavor in the finished ice cream.

Sweet cream buttermilk is obtained by churning cream that has not developed noticeable acidity; *i.e.,* cream of the same quality as that used in ice cream or retail market cream. A larger supply of sweet cream buttermilk will be available when better methods of storage are developed and continuous churning is more widely practiced. Sweet cream buttermilk has beneficial effects on the whipping ability of the mix and contributes a richness of flavor. The use of sweet cream buttermilk, either as such or in the condensed or powdered form, is especially desirable in ice cream of low fat content or in ice cream made with butter. Sweet cream buttermilk can supply nearly one-fifth of the serum solids of the mix; if a larger proportion is used, there is danger of a slight undesirable flavor. The fat content of condensed sweet cream buttermilk will be about 3 or 4 per cent and should of course be considered in calculating the ice cream mix.

Dried skim milk (now officially known as nonfat dry milk solids) is one of the concentrated sources of serum solids which is frequently used. There are three forms of dried skim milk on the market: spray process powder, drum-dried powder, and flakes. Each contains over 90 per cent serum solids. The spray process powders are more soluble than the drum-dried. The skim milk flakes have the advantage of not lumping when added to the mix. A good powder should be of fine flavor, light in color, free from darkened particles, fluffy, and easily soluble. A poor powder often is yellow in color, and granular. Dry skim milk should be bought only in such quantities as can be used before the product develops off-flavors, and preferably should be kept in cold storage. Buying in large quantities and storing at room temperatures as frequently practiced is unwise

because skim milk powders and flakes have a tendency to become stale and even rancid, and if in this condition will impart old or storage flavors to ice cream.

Powdered whole milk, up to the present time, has not been widely used in the ice cream mix because off-flavors developed fairly rapidly in storage.

Plain condensed skim milk is used more frequently than any of the other condensed milk products. The keeping quality of condensed skim milk is only a little better than that of cream; hence, the product should be used while fresh and sweet. It should be shipped and stored under refrigeration. Condensed skim milk varies from 25 to 35 per cent in serum solids.

Superheated condensed skim milk is made by heating the already condensed product to a high temperature which increases the viscosity. Its use in ice cream improves the whipping ability. The superheated product when used in ice cream should have that viscosity that will contribute to the best body, plasticity, and melt-down characteristics in the finished ice cream. It should be free from visible curd specks, and free from a pronounced cooked flavor. Formerly, superheated condensed milk and skim milk were used quite extensively. Since superheated products cost more than plain condensed products, and since they are not always of the desired uniformity, they are now used mostly by manufacturers who omit stabilizers as a point in their sales policy.

Plain condensed whole milk is perfectly satisfactory for use in ice cream. It is not in general use, however, probably because fat and serum solids can be bought separately more economically.

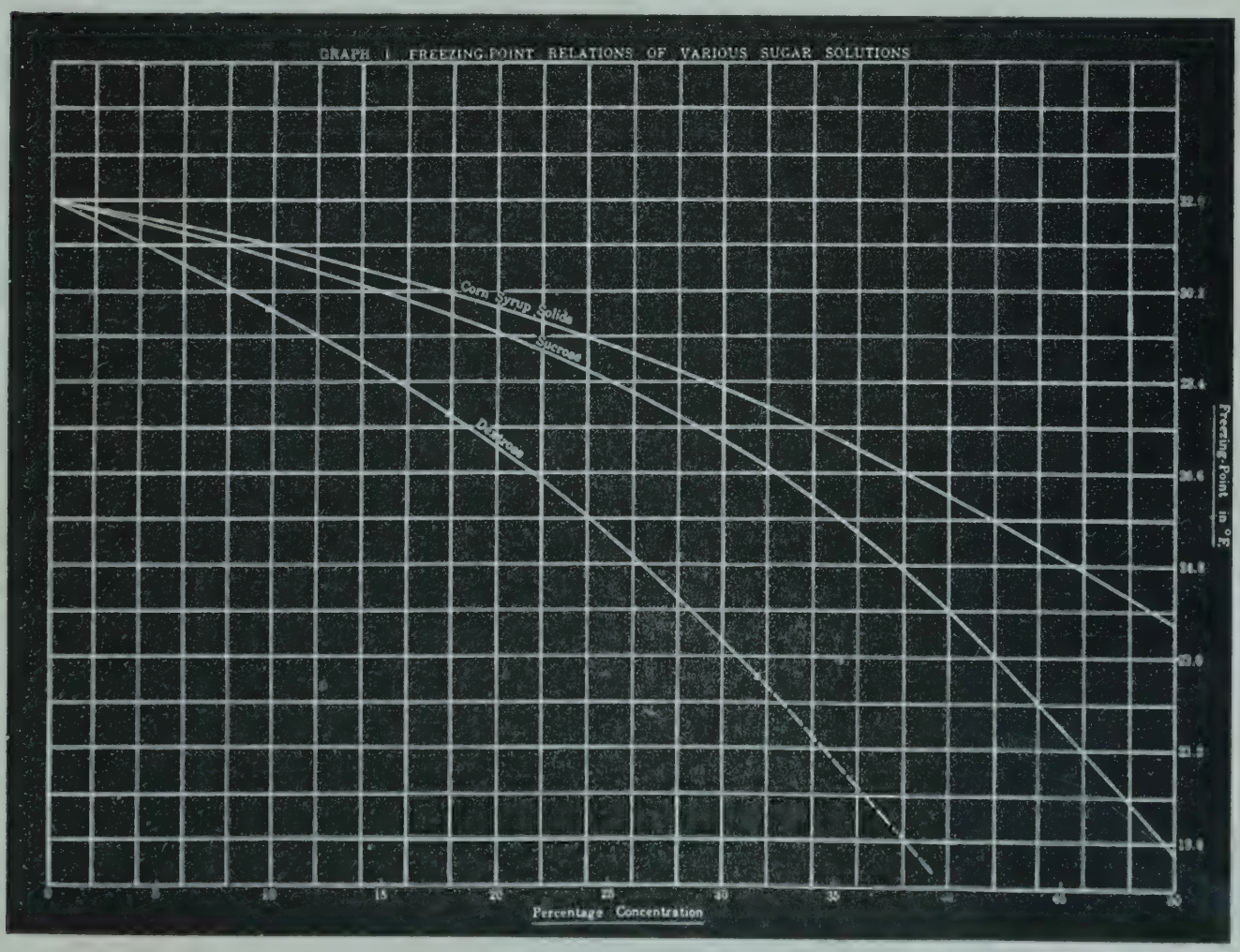
Sweetened condensed whole milk and skim milk are sometimes used as concentrated sources of serum solids. The added sugar (40 to 44 per cent) improves the keeping quality over that of plain condensed milk. The sweetened condensed milk is thick and viscous, hence not so easily handled as the plain condensed. A defect in this milk is the tendency toward crystallization of the milk sugar (lactose) into large crystals. Sweetened condensed milk should be smooth in texture, never "sandy." In judging the quality of a condensed milk product, attention should be centered on flavor—a pronounced cooked flavor will show up in the finished ice cream. Condensed milk should also be free from excessive amounts of copper or iron. These taints will appear as a metallic flavor, which in storage may develop into a tallowy or oxidized fat flavor. The acidity test should also be applied to condensed milk products. When diluted so as to contain the same serum solids concentration as skim milk, the acidity should be approximately that of fresh skim milk (about 0.18 per cent).

Other sources of serum solids are not used very extensively in ice cream. **Evaporated milk** imparts a noticeable cooked flavor and caramelized color which is undesirable in most ice creams. **Malted milk** imparts a typical flavor which limits its use. **Soluble caseins and a few low-lactose milk products** have been used to some extent. They have been suggested as a means of increasing the solids content of the ice cream without involving the danger of sandiness.

SOURCES OF SWEETENING MATERIALS (SUFECT)

The sources of sufect (sweeting effect) are ingredients containing some kind of sugar. For this reason the word "sugar" has been occasionally used to designate sufect. The different kinds of sugar do not produce equal sufect, and some ingredients consisting mainly of sugar do contain an appreciable amount of material which is not sugar.

Sucrose, commonly known by such trade names as granulated sugar, cane sugar, and beet sugar, is the most widely accepted source of sufect. Although sucrose depresses the freezing point, its concentration in ice cream is limited only by its sweetening effect. It is not satisfactory as the only source of sufect in ices and sherbets, since it may crystallize out at the surface.



Courtesy, American Maize Products Co.

Fig. 6. Freezing point relationships of the various sugar solutions.

This defect in ices and sherbets can be avoided by using one part of dextrose to three and a half parts of sucrose.

Brown sugar and maple sugar are nearly 100 per cent sucrose, but they contain characteristic flavoring materials which limit their use in ice cream. For example, only 6 per cent of maple sugar in the mix will produce a good maple flavor. Furthermore, these sugars are usually more expensive than other sources of sufect.

Dextrose, cerelose, dextrose hydrate, and **corn sugar** are trade names commonly applied to the most refined sugar obtained by the hydrolysis of corn starch. These products owe their sweetness to dextrose, *i.e.,* d-glucose. Commercially the term glucose is incorrectly applied to a variety of products which contain some dextrose. Dextrose is now quite extensively used in ice cream and is considered necessary to sherbets and ices, where it inhibits the crystallization of sucrose on the surface. Since it is only about 80 per cent as sweet as sucrose, it requires 1.25 lb. of dextrose to obtain the sufect (sweetening effect) obtained from 1.0 lb. of sucrose. Dextrose causes a lower freezing point than does sucrose because its molecular weight is lower. This effect on the freezing point limits the amount of dextrose which can be used to about 25 to 35 per cent (roughly 1/4 to 1/3) of the total desired sufect. Usually dextrose is more economical than sugar as a source of sufect. Dextrose has a slightly greater tendency than cane or beet sugar to become lumpy when exposed or stored in slightly moist air.

Corn syrup solids, such as "Frodex" and "Dri-Sweet" are among the products obtained in the hydrolysis of corn starch. They contain the sugars dextrose and maltose together with dextrine (pro-sugar), but usually contain no starch. They are white granular solids and about equal to cane sugar in their tendency to become lumpy when exposed to moist air. They usually have been more economical than cane sugar, but because of their lower sweetening effect it requires about 2.1 lb. of Frodex or corn syrup solids to produce the sufect obtained from 1.0 lb. of sucrose. The dextrins which they contain actually raise the freezing point slightly. These dextrins also increase the total solids of the mix and supply some stabilizing effect against coarseness. The effect on the freezing point and smoothness seems to give corn syrup solids an advantage over dextrose not only in sherbets and ices but also in ice creams of low total solids concentration. Usually it is recommended that not more than one-fourth to one-third of the total sufect be supplied by corn syrup solids.

Lactose, the sugar that is found only in milk, is not as sweet as sucrose and is much less soluble. When the water portion of the mix contains as much as 9 per cent lactose, the lactose may separate out in crystals large

enough to be discernible and produce an undesirable "sandy" feel in the mouth. This property definitely limits the concentration of lactose to be used in ice cream. The source of lactose is the serum solids (s.s.) of dairy products, and about 54 per cent of these solids is lactose. Therefore the maximum concentration of lactose that can be safely used also establishes the maximum concentration of serum solids.

This maximum concentration of serum solids to avoid sandiness varies somewhat with conditions under which ice cream is produced and stored. For instance, if ice cream is frozen at the higher temperatures generally prevailing in batch freezers, or if excessive amounts of corn syrup solids are used in the mix; if there is much fluctuation in storage temperatures, and if the ice cream is likely to be held in customer's cabinet for longer periods (14 days or more), before it is consumed, such ice cream may be considered as being subjected to rather severe conditions and any or all of these unfavorable factors are likely to produce sandiness. Where such conditions have to be met experiments have proved that the maximum concentration of lactose (and therefore of serum solids) that can safely be used is less than for ice cream that is produced and stored under more favorable conditions.

This maximum concentration of serum solids is expressed in pounds of water per pound of serum solids as follows:

1. **For ice cream produced under conditions as severe** as those described above it has been determined that if the mix contains 6.4 lb. of water per lb. of serum solids, there should be very little danger of sandiness in the ice cream. This proportion (6.4 lb. water plus 1.0 lb. s.s.) becomes the **Factor 7.4** to be used in a formula for calculating the amount of serum solids to be used for ice cream subjected to these rather severe conditions.

2. **Under average commercial conditions** where there is less danger of sandiness a concentration of 5.9 lb. water per lb. serum solids can ordinarily be used. **The Factor then becomes 6.9,** (*i.e.,* 5.9 plus 1.0).

3. **For ice cream to be consumed within a week** after it is placed in retailer's cabinet, in which time sandiness rarely develops, the normal concentration is 5.4 lb. water per lb. serum solids, and the **Factor is 6.4.**

These foregoing Factors are used as follows in:

Formula For Calculating The Per Cent of Serum Solids To Use In An Ice Cream Mix.

$$\frac{100 - X}{\text{Factor}} = \%$$ serum solids to use under conditions for which the Factor applies.

In the equation 100 = total mix.

X = (the sum of the percentages of all solids except serum solids)

EXAMPLE 1: If a mix contains 12 per cent fat, 14 per cent sugar, 0.5 per cent egg yolk solids, and 0.5 per cent stabilizer, what would be the maximum percentage of serum solids which could be safely used under average commercial marketing conditions?

Substituting in the Formula:

$$\frac{100-(12+14+0.5+0.5)}{6.9} = 10.58 \text{ per cent serum solids.}$$

EXAMPLE 2: A mix containing 12 per cent fat, 11 per cent serum solids, 15 per cent sufect, 0.5 per cent egg yolk solids, 0.5 per cent stabilizer and 40.15 per cent total solids (due to using Frodex) might be expected to become "sandy" if subjected to rather severe conditions, because:

$X = 40.15 - 11.0$ or $29.15 = \%$ of all solids except serum solids, and

$$\frac{100 - 29.15}{7.4} = 9.57 \text{ per cent serum solids.}$$

This means that 9.57 per cent serum solids is the maximum concentration of serum solids that would not be likely to cause "sandiness" even under rather severe conditions.

Sugars in the form of syrups may also be used as a source of sufect. They sometimes contain two or more sugars together with small amounts of other substances which may impart some color or flavor. These colors and flavors usually limit their use in ice cream. Their sufect depends upon their sugar concentration and the nature of the sugars present. The exact concentration of each sugar present as well as the concentration of total solids may vary considerably depending upon the source and treatment of the original syrup. They are frequently messy and difficult to measure when only part of a package is used. This can be avoided by heating the syrup in its original package and using an entire package every time. The use of syrups also requires the use of at least some more highly concentrated milk products to compensate for the water contained in the syrup. When added after homogenization they may settle to the bottom unless the mixture is heated and thoroughly mixed. One advantage is that they are often a more economical source of sufect, especially if the ice cream plant is located near a sugar refinery so that the syrup can be transported in tank cars or trucks and pumped into tanks at the ice cream plant. Also, they may be more sanitary and less likely to contain insoluble foreign material provided the packages do not leak and suitable provisions are made to transfer the syrup without exposure to possible contamination. The total solids concentration of sucrose syrups is usually measured by "degree Brix" which is the percentage of sucrose assuming all the solids to be sucrose. This is a safe asumption for practical purposes. Corn syrup, and many others, are often labeled with a Baumé reading. This reading is based on the specific gravity of the syrup

and therefore is a measure of the total solids concentration. However, it does not indicate the kind or amounts of the various sugars and dextrins present in the syrup. Baumé and Brix are not the same. Brix gives the percentage sufect (sweetening effect) only for sucrose syrups. Baumé readings have to be calculated into terms of specific gravity from which the total solids concentration can be calculated.

Baumé readings and percentage total solids should not be called "sweetness," "per cent sweet," nor confused with sufect (the sweetening effect) which depends upon the kind and concentration of sugar present.

Liquid sugar or No. 1 syrup are trade designations for the colorless sucrose syrup used by ice cream manufacturers. The bill and delivery slip generally specify the Brix reading which is not only the percentage of sucrose (*i.e.,* the percentage sufect) but also the percentage of total solids of the syrup. The effect on the freezing point is the same as that of the sucrose it contains. As yet, deliveries of liquid sugar are made only in tank cars and tank trucks, so its use has been restricted to ice cream manufacturers having special facilities for this type of delivery.

Table 10: Relation of Baumé to Concentration of Sucrose (Cane or Beet Sugar) Syrup

Degrees Baumé M—145 68° F.	*Degrees Brix** 68° F.*	*Weight* per gal. 68° F. lb.*	*Sugar per gal. lb.*	*Water per gal. lb.*
33.0	61.0	10.78	6.58	4.20
33.5	62.0	10.83	6.71	4.12
34.0	63.0	10.88	6.85	4.03
34.5	63.9	10.92	6.98	3.94
35.0	64.9	10.97	7.12	3.85
35.5	65.9	11.02	7.26	3.76
36.0	66.9	11.07	7.41	3.66
36.5	67.9	11.13	7.56	3.57
37.0	68.9	11.18	7.70	3.48
37.5	69.9	11.23	7.85	3.38
38.0	70.9	11.28	8.00	3.28
38.5	71.9	11.33	8.15	3.18
39.0	72.9	11.39	8.30	3.09
39.5	73.9	11.44	8.45	2.99
40.0	74.9	11.49	8.61	2.88

*One U.S. gallon of water at 68° F. weight 8.322 lb.
**Degrees Brix=per cent sucrose by weight for *sucrose* syrups.

Molasses and maple syrup (the syrups of brown sugar and maple sugar respectively) usually carry too much flavoring material to permit their general use.

Invert sugar is a mixture of equal parts of glucose and fructose resulting from hydrolysis of sucrose, and is generally obtained in the form of a syrup. It is sweeter than sucrose and the increased sufect obtained by hydrolyzing

a given weight of sucrose is sufficient to justify the inversion process at a time of sugar scarcity. Even though this invert sugar syrup contains from 25 to 30 per cent water, one pound of invert sugar syrup will produce almost as much sufect as one pound of sucrose. However, it is similar to dextrose in depressing the freezing point and therefore should be used to supply not more than one-third of the total sufect in the mix.

Invert sugar may be prepared by the following procedure recommended by Dr. H. H. Sommer in *Theory and Practice of Ice Cream Making*: Heat 26 lb. of water to 180° F. and slowly add 74 lb. of sucrose to avoid having much undissolved sugar present at any one time. When the syrup is at 180° F. shut off the heat and add 36.3 cc. hydrochloric acid (40%, sp. gr. 1.20) with suitable stirring to distribute it evenly. There will be a temperature rise due to the chemical action. After the acid has acted 15 minutes, cool promptly, and when the temperature is down to about 140° F., add sodium bicarbonate at the rate of 1 1/3 oz. per 100 lb. of syrup, to neutralize the acid and then continue the cooling. This procedure will give approximately 95 per cent complete inversion.

Corn syrup, frequently incorrectly called "glucose," is made either by acid hydrolysis or by enzyme hydrolysis of corn starch. It contains no sucrose, but does contain a variable amount of dextrose and maltose with some impurities depending upon the degree of refining used in its manufacture. It may be considered as a source of dextrose. While its sugar content, and also total solids content, varies considerably, it is usually safe to assume that 1.5 lb. of corn syrup will replace 1.0 lb. of sucrose. The effect on the freezing point is similar to that of corn syrup solids.

"Sweetose" is a trade name for corn syrup made by the enzyme hydrolysis of corn starch. It is generally marketed at about 43° Baumé and a sugar concentration that gives a sufect of 67 per cent. Therefore it will require 1.5 lb. of sweetose to replace 1.0 lb. of sucrose in the ice cream mix.

Other syrups, such as honey, malt syrup, *etc.*, are rarely used in ice cream because of their characteristic and pronounced flavor.

Saccharin, the first so-called "artificial sweetener" to be used commercially, is not a sugar, but a product derived from coal tar. It has a sweetening effect up to 550 times that of sucrose. The Federal food laws (U.S. Dept. Agr., Food Inspection Decision 135) prohibit the use of saccharin in foods since the continued consumption of more than 0.3 gram per day is liable to impair digestion because of its antiseptic power and preservative action. However, special permission is sometimes granted for its use in making so-called "diabetic ice cream." In such cases, as little as ten grams or less of saccharin per 100 pounds of mix will approximate 15 per cent sufect.

Thus it is necessary to use a high concentration of fat to supply the needed total solids, and about 4 to 5 per cent glycerine to reduce the firmness of the ice cream. Such a product is a poor substitute for real ice cream but does offer some variety to a restricted diet.

"n-propoxy" is a trade designation for 1-n-propoxy-2 amino-4-nitrobenzine, a benzine derivative and not a sugar. Its sweetening properties were reported about 1940-45 by Prof. P. E. Verkade of the Netherlands as 4000 times that of sucrose. It is easily obtained in the pure state as crystals which are orange in color and very slightly soluble in water. Its use in ice cream should be subject to the same supervision and restriction as that placed on saccharin.

"Dulcine" (p-phenetyl-urea, or $NH_2CONH\ C_6H_4OC_2H_5$) is also rarely used in ice cream even though it is supposed to be from 70 to 250 times as sweet as sucrose. Its use should be subject to supervision and restriction similar to those for saccharin.

Sugar-Saving Suggestions. In times of sugar shortage the following suggestions should be helpful to the ice cream manufacturer in stretching his allotment of cane and beet sugar:

1. Use more of other sources of sufect such as corn sugar and corn syrup solids, better known as Frodex, Sweetose, Corn Syrup, *etc.* As stated elsewhere in this chapter these products can be used to replace as much as one-fourth to one-third of the sufect required in the formula. Many ice cream makers are coming to believe that a finer quality of ice cream is produced when part of the sucrose is replaced by corn syrup solids.

Maple sugar, maple syrup, honey, and sorghum, when available and not too high priced, also can take the place of a limited amount of cane or beet sugar in the mix.

2. Reduce the sufect content in the ice cream, by replacing part of it with milk solids. Research carried on by the Bureau of Dairy Industry of the U.S.D.A. revealed the fact that sweetness of ice cream depends upon the concentration of sugar in the water of the mix. Therefore if part of the free water content of the mix is absorbed by the addition of milk solids, obviously there will be less volume of water to dissolve the sugar, and this higher concentration will taste sweeter. It was found that a saving of as much as 20 per cent of sugar can be made without lowering the degree of sweetness of the ice cream.

3. Educate the public to require a less sweet ice cream. It is safe to say that if no direct comparison is made with a sweeter product, the average consumer is not likely to notice a reduction of 1, 2, or even 3 per cent of sufect

content in his ice cream. This reduction in times of great scarcity would stretch considerably the efficiency of the sugar allotment.

4. Invert up to one-third of the cane or beet sugar required in the mix. Since invert sugar tastes sweeter its use in time of sugar scarcity is recommended even though some additional labor and expense is involved in the inversion process. It should be remembered, however, that if invert sugar is used in the mix, no other source of sufect, except sucrose, can be used with it.

SOURCES OF EGG YOLK SOLIDS

Fresh eggs are seldom used in ice cream except in rich ice creams, such as puddings. The cost of fresh eggs is generally such that they can be economically used only in ice cream retailing at higher than average prices.

Frozen egg yolks and powdered egg yolk are used by many ice cream makers because the egg yolk solids improve the whipping ability of the mix. Usually not more than 0.5 per cent of egg yolk solids in the mix is needed for this purpose. Egg yolk solids are especially desirable in mixes in which butter or butter oil is used as the main source of fat. Investigations have shown that the egg yolks improve the rate of whipping more if they are sweetened with 10 per cent of sugar before they are frozen.

The use of egg yolk solids produces the following beneficial effects:

1. Increased rate of whipping, particularly for slow whipping mixes.
2. Firmer ice cream at a given drawing temperature.
3. Less change in percentage overrun while unloading the freezer.
4. Improved appearance while ice cream is melting.
5. Slightly improved texture.
6. Increased food value.

The disadvantages are the cost of the egg yolk and the fact that frequently it may be slightly off-flavored.

TABLE 11. APPROXIMATE DATA ON EGG PRODUCTS TO SERVE AS A GUIDE IN CALCULATING MIXES

Egg Product	*Pounds per dozen eggs*	*Eggs per lb. of egg product*	*Egg Yolk solids per cent*	*Egg fat per cent*	*Total solids per cent*
Fresh eggs (edible portion)	1.17	10.0 to 10.6	20.0	10.5	26.3
Egg yolk	0.50	24	50.5	33.3	50.5
Egg white	0.67	18	.....	0.2	13.8
Dried whole egg	0.33	36	55.0	40.0	94.0
Dried egg yolk	0.25	48	94.0	62.5	94.0
Dried egg white	0.083	144	.....	1.4	96.0

CHAPTER VI

STABILIZERS AND EMULSIFIERS*

Among the leading stabilizers used in the making of commercial ice cream, sherbets and ices are: gelatin and modified gelatin; sodium alginate and its modified form Dariloid; Irish moss and its modified forms such as Krageleen; agar-agar; C.M.C.—a cellulose derivative; pectin—derived chiefly from citrus fruits; carob bean gum; mucilaginous extracts from quince seed, psyllium seed, *etc.*; gum exudates such as tragacanth, karaya and others.

Gelatin—the first of the commercial stabilizers is still most widely used. Its advantages lie in its ability to form a gel in the mix during the aging period as well as during the freezing process, and even after the frozen product is placed in the hardening room. Its peculiar gel structure and its great affinity for water prevent the formation of large ice crystals in ice cream, and contribute to smoothness in texture, and firmness in body of the frozen product. Although not a complete protein its amino acids do contribute slightly to the food value. It is generally thought less satisfactory than vegetable stabilizers for sherbets and ices because it has a tendency to produce too high an overrun which is often associated with poor body and texture in these products.

The amount of gelatin to use depends on many factors such as the source of the gelatin, whether from calf or pork skins or bone material, its gel strength as measured by the Bloom Test, its viscosity value, the composition of the mix, *etc.* In general the amount to use is approximately the amount required to produce a melt-down (in the evenly-melted ice cream) of about the same consistency as aged 40 per cent sweet cream. This amount usually is between 0.25 and 0.5 per cent for a 250 Bloom gelatin.

Tests for Gel Strength[1] Several tests have been developed to determine the gel strength and to serve as guides to the amount to be used in the mix. Among these are the Bloom Test[2] for Gel Strength, the Dahlberg Test (see chapter XXI) and the "Protein-Nitrogen Content" Test developed at University of Illinois. In a general way it may be said that, other factors being equal, the gelatin that carries the greatest gel strength per unit of cost is the one to select. Good quality gelatin should have low bacteria count and should be practically odorless and colorless or, if made from calf products, of light amber color.

"Vesterine," a modified gelatin, has recently come into use, but is not yet

* J. H. Frandsen in 1915 used the word "Stabilizer" to designate a group of substances which at that time were generally referred to as "holders," "colloids," "binders," and "fillers."— The Manufacture of Ice Creams and Ices.—Frandsen and Markham—Pub. Orange Judd Co. 1915.

[1] These tests are not too satisfactory but they may be considered as a fairly good guide as to the strength of the gelatin.

[2] This test is accepted by the Gelatin Research Society of America, Inc., as a standard for gel strength.

widely accepted. It is composed of gelatin and a monoglyceride or a monostearate. It stabilizes the fat emulsion and improves the whipping quality of the mix and the texture of the finished product.

Sodium alginate and a modified form sold under the trade name of "Dariloid" are rather widely used vegetable stabilizers. Their basic stabilizing principle, algin, is extracted from a giant ocean kelp growing on the shores of California and Japan. Dariloid seems to consist almost entirely of sodium alginate, with small amounts of sugar and sodium citrate added to assist its solubility and to standardize its stabilizing properties. This product improves whipping ability and leaves a slightly cleaner flavor in the mouth —two distinct advantages. Dariloid dissolves properly only when added to the mix at about 155° to 160° F., which may be a disadvantage under certain methods of processing. A slightly smaller amount of Dariloid is needed to give the same stabilizing effect as gelatin.

Irish moss and a modified form sold under the trade name of "Krageleen" contain the basic stabilizing principle carrageenin. This is extracted from carrageen (Irish moss), a seaweed growing on the coast of Massachusetts, France, and Ireland. In stabilizing value these products are comparable to a 250 Bloom Test gelatin, and (it is claimed) can be added to the mix as easily as gelatin.

Agar-agar—a product extracted from red algae growing on the Pacific coast has been recommended in combination with gums or gelatin for use as a stabilizer in sherbets and ices. Although it swells and absorbs large quantities of water and thus prevents coarseness in the finished product, it is not easily dispersed in the mix and tends to produce a crumbly body. It is also high in cost.

C.M.C., the trade name for sodium carboxymethyl cellulose, forms the basis of stabilizers which are now being accepted by the ice cream industry. It has high water-holding capacity and is easily dissolved in the mix—two qualities of a fine stabilizer—and it acts also as an emulsifier. The amount to use is slightly less than of gelatin. It does not form as firm a gel as gelatin and some of the vegetable stabilizers but seems to have merit for use in ice cream, and especially in sherbets and ices.

Pectin is a carbohydrate obtained mainly from citrus fruit. It is especially desirable as an ingredient in the syrups and fruits used in making aufaits and rippled effects in ice cream, and is also effectively used in sherbets and ices. However, it is not very satisfactory as a stabilizer for ice cream. Purified sugar beet pectin forms a weaker and less brilliant gel than citrus pectin.

Carob (locust) bean gum, a product imported from Europe, is an ingredient of stabilizers sold mainly for use in sherbets and ices. Its principal

advantage in these products is that it inhibits overrun. Since it has a tendency to cause curdling of the milk proteins, its use in ice cream is limited, and heating to temperatures above 100° F. should be avoided.

Other Gums such as tragacanth, arabic, karaya, or India gum, are exudates from incisions made in the bark of certain trees and plants growing usually in the warmer regions of the earth. They find their chief use as ingredients in stabilizers for use in ices and sherbets and in the so-called Ice Cream Improvers. The mucilaginous extracts from some plant seeds (quince and psyllium) are less widely used.

"Ice Cream Improvers" are used by some manufacturers to improve the body and texture of ice cream. Some of these improvers consist mainly of the gum type of stabilizer (one or a mixture of two or more gums) and are sold as ice cream improvers under various trade names. Other improvers contain an enzyme such as rennin (rennet extract) or pepsin, capable of coagulating casein. Partial coagulation of the casein by these enzymes effects the body and texture of the ice cream. Therefore care must be taken to check the coagulation at the right time. If such an improver is used it seems preferable to add it to the mix before pasteurization since the heat will destroy the enzyme and thus prevent too much coagulation and whey-ing-off. Unless the enzyme is destroyed by heat it will continue to work slowly even during the hardening period, and as a result the ice cream may shrink in the can or package. Ice creams containing improvers often have a curdled appearance when melted, due to a slight excess in the coagulation of the casein. The benefit of improvers is questionable except possibly in ice cream of low total solids content.

Antioxidants are substances which inhibit the development of "oxidized" flavor, often a troublesome defect in ice cream. They are successful only when added before the objectionable flavor develops. Several substances are known to have this effect. Some of these are oat flour (a somewhat modified oat flour is being marketed under the trade name, Avenex), an extract of oat flour, an extract of lettuce leaves, some vitamins, tannin, *etc.* The oat flour products are also credited with some merit as stabilizers. Although these products are frequently found in foods, their use in ice cream is illegal in some states.

EMULSIFIERS

Emulsifiers, it is thought, are substances that collect on the surface of fat globules and the surface of the air cells. They seem to favor the development of small air cells and make them more uniform in size. Consequently their beneficial effect is similar to the effect of egg yolk solids, and they may be considered a substitute for the desired active constitutent of egg yolk solids except in the making of frozen custards. Emulsifiers slightly improve

the whipping ability of the mix and the texture of the ice cream—yielding a product that looks "drier" when "soft." Like egg yolk solids they exert some stabilizing effect so that less stabilizer is required.

Some disadvantages in the use of emulsifiers are: homogenization of the mix is essential to obtain best results; their use is illegal in some states; and some investigators think that they tend to favor the development of the defect called "shrinkage."

CHAPTER VII

FLAVORING AND COLORING MATERIALS

Frozen desserts are valued mainly for their pleasing flavor and their cooling and refreshing effects. Since there are so many kinds of flavoring material and since they are sold under so many brands and grades, it is well to understand their sources and to select and buy with great care. Among the flavoring substances that play a more or less important part in frozen desserts are vanilla, chocolate and cocoa, fruits and fruit extracts, nuts, spices, and sugars. In the selection of flavoring materials it is important to consider the quality of the ice cream mix in which they are to be used since slight off-flavors in it may obscure the delicate flavor of the flavoring material to be added. Local preference of consumers is also important since they may not appreciate the finer, delicate flavors, but prefer the stronger, harsher ones.



Courtesy, David Michael and Co., Philadelphia.

Fig. 7—Vanilla vine and bean pods.

VANILLA

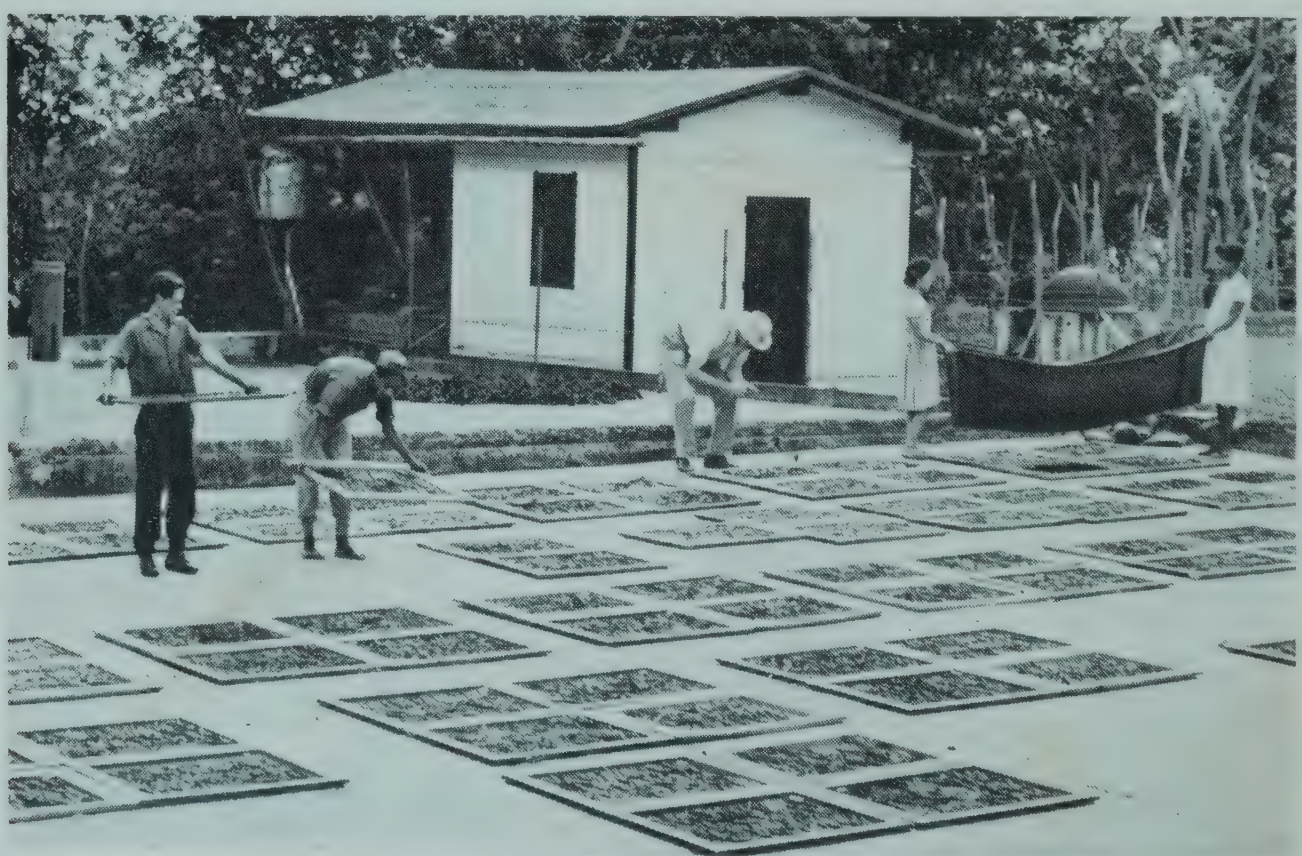
Vanilla is without exception the most popular flavor for ice cream. Records show that about 75 per cent of all ice cream made is vanilla flavored. This flavoring material is usually obtained in extract form, but there is a rapidly growing demand for vanilla concentrates and paste, and for powdered vanilla and sugar preparations.

Pure vanilla is derived from the bean or seed pod of a plant, Vanilla planifolia, belonging to the orchid family which is indigenous to southeastern Mexico where it was first used by the native Aztecs to flavor their cocoa. The plant was introduced into other tropical countries where it is

now cultivated quite extensively, but rarely does it seem to produce the fine flavor of the bean grown in Mexico. Common types of vanilla beans arranged in descending order of quality for comparable grades are: Mexican beans; Bourbon beans; South American beans; Java beans, and Tahiti beans. The least desirable of these, the Tahiti bean, is harsh in flavor. However, the grade of the beans is more significant than the type especially in the better qualities. The Tonka bean, which is a legume, and Vanillons, a wild type of vanilla bean, can not legally be used in making pure vanilla extract, but are sometimes used in making imitation vanillas.

Vanillin is the principal flavoring essential in Vanilla. However, there is no free vanillin in the beans when they are harvested, but it develops gradually during the curing period from glucosides which break down during the fermentation and "sweating" of the beans. The sweating process consists of alternately drying the beans in the sun and wrapping them up at night so that they heat and ferment. This process, which is continued until the flavor and aroma are developed, takes four weeks to four months and reduces the beans to sufficient dryness so that they will not mold. Beans are sometimes artificially dried but this produces a product of inferior quality.

At the end of the curing period the pods are carefully sorted into various grades based on their quality. Since split and bruised pods produce an inferior grade of extract they are sold, at lower prices, as "splits" and "cuts"



Courtesy, David Michael and Co., Philadelphia.

Fig. 8. Curing the vanilla bean—the process which develops the vanillin flavor.

along with other inferior grades, and extracts made from such grades are used chiefly in making vanilla compounds.

Artificial or Synthetic vanillin as made in the laboratory is a product of slightly different flavor but the same general composition as that which occurs naturally in vanilla beans. The formula for vanillin is ($C_8H_8O_3$). Coumarin ($C_9H_6O_2$) is identical with the coumarin in the Tonka bean. It has a harsh flavor.

CLASSIFICATION OF VANILLA FLAVORINGS

Vanilla flavorings of which there are many variations on the market may be grouped into these general classes:

A. **Pure Vanilla Flavorings:**

1. **Pure Vanilla Extract** is prepared by a slow percolation process of finely cut vanilla beans in an alcohol solution (about 45% of alcohol.)

The Federal Standard for vanilla extract is "the soluble matter from at least 10 grams of beans in 100 cc. of alcohol, with or without added sugar, glycerine, or coloring matter." This amounts to 13.35 oz. of beans to make a gallon of extract of 10 per cent strength—the official minimum standard. These pure vanilla extracts are generally of such strength that 5 or 6 oz. of the extract are required to flavor 10 gallons of finished ice cream.

Concentrated vanilla extract is made by distilling off a large part of the alcohol, usually in vacuum, until the strength is 8 or 12 times the strength of the standard product. The so-called "double strength" extracts require only 3 to 4 oz. to flavor 10 gallons of ice cream.

Pure vanilla powders are made by mixing finely cut or ground vanilla beans with sugar, or by extracting the flavoring material with alcohol, evaporating the product, and mixing the residue with sugar to absorb the flavoring material.

Vanilla paste is made by extracting the flavoring from the bean in the usual manner, but the alcohol is recovered, and the residue mixed with sugar to form a paste. Three to 5 oz. of powder or paste are usually needed to flavor 10 gallons of ice cream. The concentrated products are more economical since the alcohol can be reused.

2. **Pure Vanilla Flavor** is made by the same extraction or percolation process as Pure Vanilla Extract except that propylene glycol is used instead of ethyl alcohol, and therefore the product cannot legally be labeled an "extract."

3. **Vanilla with Vanillin.** This product must contain at least 51% of pure vanilla extract or pure vanilla flavor and not over 49% of vanillin, and must be so labeled.

B. **Imitation Vanilla Flavorings.** These may be grouped as follows:

1. **Blends** of pure vanilla extract or pure vanilla flavor with varying amounts of vanillin added.

2. **Compounds** consisting of some pure vanilla extract or pure vanilla flavor (25-50%) to which may be added water, alcohol, propylene glycol, vanillin, coumarin, caramel color, *etc.*

3. **Preparations that contain no vanilla bean extract or flavor** but may consist of any combination of substances used as fortifying materials in the other grades of imitation vanillas. This type is not considered satisfactory for use in flavoring ice cream when used alone.

Imitation vanilla powder contains sugar, vanillins, coumarin, and oleoresins.

In general it may be said that the amount of pure vanilla used in imitation vanilla flavorings may vary greatly, but the kinds and amounts of fortifying materials used in them must be stated on the label and they must be labeled imitation. They obviously are less expensive than natural pure vanilla flavorings.

For those who wish to economize on vanilla costs a suggested reinforcement for a vanilla extract is 2 ounces of vanillin to the gallon. If coumarin is to be added to this, no more than ⅛ ounce should be used, preferably less. A highly reinforced vanilla should not exceed 8 ounces of vanillin plus an ounce of coumarin as additions to the pure vanilla base.

An artificial flavoring extract strong enough so that ½ ounce is sufficient to flavor 10 gallons of ice cream usually contains 12 to 14 ounces of vanillin and 5 to 6 ounces of coumarin to the gallon. Fortunately, these imitations are seldom used exclusively in ice cream.

CHOCOLATE AND COCOA

Chocolate and cocoa rank second only to vanilla as flavoring for ice cream. They are obtained from the cacao bean, the fruit of the tree, Theobroma cocao, growing in such tropical regions as Mexico, Central America, Ecuador, Venezuela, Brazil, West Indies, the African Gold Coast, and the East Indies.

The almond-sized cacao beans or seeds develop in a large pulpy pod—20 to 30 beans to the pod. The ripened pods, rich golden red in color, are cut from the trees, gathered in piles and left to ripen further for about 48 hours after which they are slashed open, the beans removed and placed in vats or bags to heat and ferment for about ten days, or until the characteristic flavor and cinnamon-red color develop. The beans are then washed clean of the dried pulp, are dried slowly and sufficiently to prevent mold

growth, and are then sorted and graded prior to shipment to manufacturers of chocolate and cocoa.

Processing the cocoa beans. At the factory the beans are first mechanically cleaned. Then they are roasted to drive off the moisture and to bring out the special chocolate flavor and aroma. The roasted beans are then cooled quickly by forced air, and are next run through a winnowing machine which crushes them into small pieces and separates the shells from the nibs, the seed part which is made into chocolate and cocoa. These nibs, containing approximately 50 per cent of the fat of the bean, are then placed between heavy stone grinders or mills which reduce them to a liquid by the heat created by the friction of milling.

Chocolate Liquor or Pure Bitter Chocolate is the trade name for the liquid chocolate produced by the processes described above. This liquor may then be cooled in molds and put up in large slabs, or in ½-pound packages such as are sold in grocery stores as bitter cooking chocolate, or it may be further processed into cocoa.

Sweet Milk Chocolate may be made from the chocolate liquor by adding the necessary proportions of sugar, milk, and cocoa butter, with or without vanilla flavoring. The blending of these ingredients requires a considerable amount of skill and special machinery.

Natural Process Cocoa is made from chocolate liquor by subjecting the liquid to high pressure in hydraulic presses. This process removes a large amount of the cocoa (fat) butter, usually about 38 or 40 per cent of the total, and leaves a hard, dry cake which normally contains about 22 per cent fat, though some cocoas contain more and some less. It also contains nearly all the flavoring material from the cocoa bean. The fat is practically tasteless. This cocoa cake is then put through a number of processes known as milling which result in the finely sifted cocoa.

Dutch Process Cocoa is made just as is the Natural Process Cocoa, except in one particular. In the Dutch process the beans are treated with certain alkalis at the time of roasting to break up the cell structure. This alkali treatment makes the cocoa more soluble and gives it the desired darker color which distinguishes Dutch Process from Natural cocoa. It also aids in bringing out the full fine chocolate flavor when the cocoa is used in the finished product. Because the alkalis counteract the puckery acid taste which is found in natural cocoa, the Dutch Process cocoa leaves no bitter taste when used as flavoring in ice cream.

A defect which sometimes appears in chocolate ice cream made with Dutch Process cocoa is the formation of a greenish-black coloration where the ice cream comes in touch with exposed iron on the inner surface of the packing cans, as is the case if the cans are rusty or the tinning is scratched

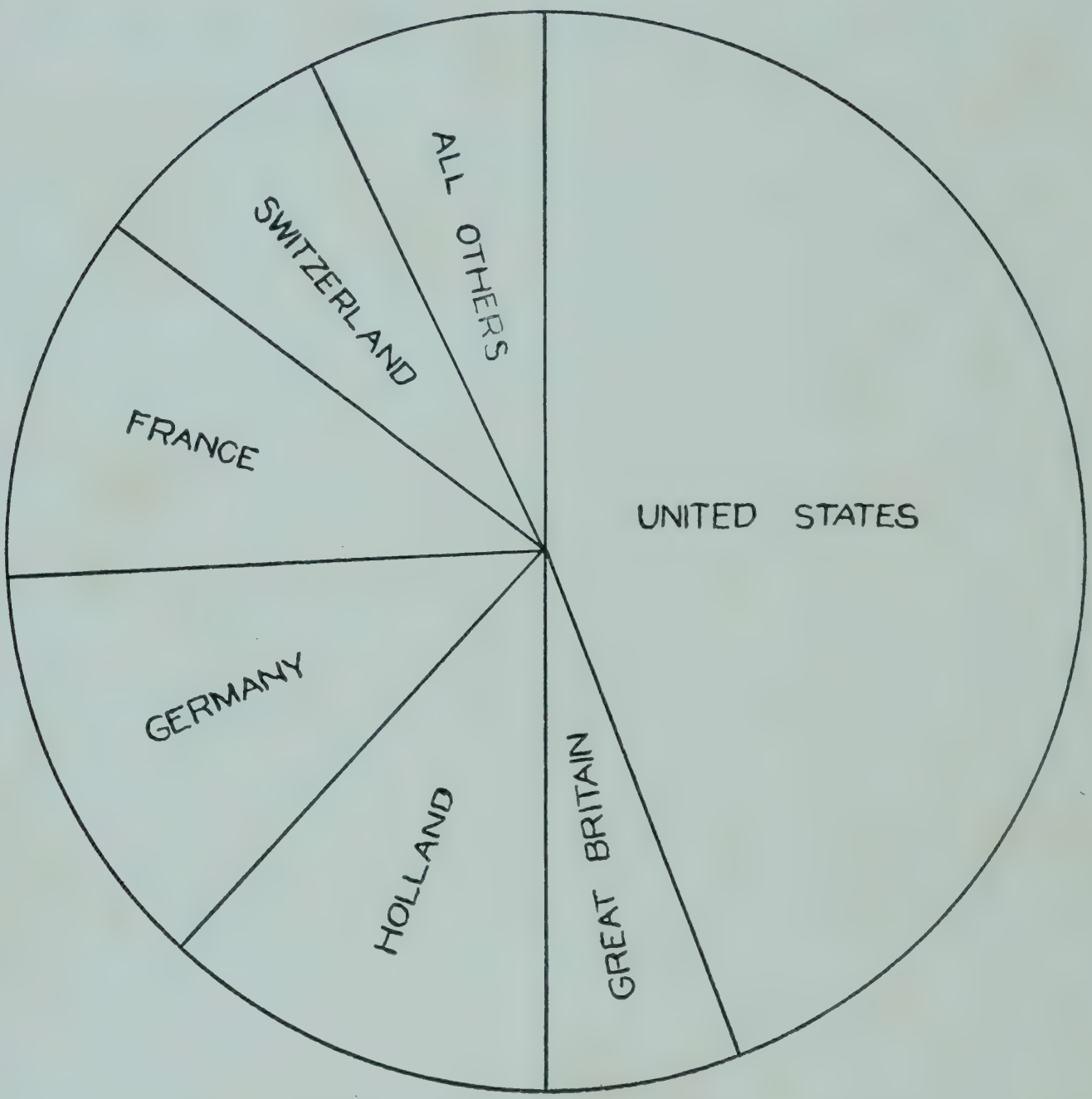


Fig. 9. Graph showing where cocoa and chocolate are used.

or worn off. In the "Dutching" of the cocoas, the tannins which they contain are made soluble by the added alkalis, and they react with the iron to form ferric tannate which gives the greenish-black discoloration to the ice cream. This discoloration can be avoided by using well-tinned cans, paper can-liners, or paper containers.

Concentration of flavor in cocoa. Cocoa is more concentrated for ice cream flavoring than chocolate liquor because it contains a higher percentage of the real chocolate flavor. The fat which has been removed is nearly tasteless and adds very little flavor to the ice cream mix. This is shown in the following equation:

100 lb. of cocoa contains 78 lb. flavor plus 22 lb. fat.

100 lb. chocolate liquor contains 48 lb. flavor plus 52 lb. fat. It is evident,

therefore, that in 100 lb. of cocoa there is approximately 30 lb. more of real chocolate flavor than in 100 lb. of chocolate liquor. Due to the prevailing high price of cocoa butter, it is more economical for the ice cream manufacturer to use cocoa rather than chocolate liquor.

The color of cocoa is the resultant of several factors such as:

1. The blend of beans
2. The fat content
3. Treatment (Dutching)
4. Rate of chilling

The rate of chilling is an important factor and influences color by affecting the size of the fat globules in the cocoa. This influence is lost when the cocoa is used.

Cocoa is seldom adulterated. Sugar, starch, cocoa shells, ground wood fiber, or iron oxide, which at one time were often used as adulterants, are seldom found in cocoas now. Some companies do, however, add to cocoa some aromatic substance as cinnamon, oil of cloves, oil of bitter almond, or vanillin. Some of these substances in small quantities will give cocoa a higher, pleasant aroma.

The amount of cocoa or chocolate liquor to use in ice cream depends upon several factors, such as consumer preference, color desired in ice cream, strength of flavor, fat content of flavor, *etc.* The usual recommendation is 4 lb. of cocoa or 6 lb. of chocolate liquor to 100 lb. of mix. Extra sugar should be added to compensate for the bitter flavor of the cocoa, the usual recommendation being the same weight of sugar as of cocoa or chocolate. The tendency seems to be to flavor chocolate ice cream too highly. It is apparent that a better product could be made by reducing the amount of flavor and using instead a finer grade of cocoa or chocolate liquor.

Preparing the chocolate syrup. The small ice cream manufacturer usually prefers to flavor chocolate ice cream by adding syrup at the freezer. The syrup should be made up in a chocolate kettle or double boiler. Mix the sugar and cocoa or chocolate together and add enough water to make a heavy paste. Heat gradually and add water slowly as necessary. (The final syrup should contain enough water so that it will pour when cooled.) The syrup should be heated to the boiling point and cooled before using so as not to prolong the freezing operation.

When to add. Wherever possible, an entire chocolate mix should be made by adding the cocoa (or chocolate) and extra sugar to the mix, along with the other dry ingredients, before pasteurization. The temperature of pasteurization is sufficient to incorporate the flavor properly. A chocolate mix made in this way whips more rapidly than plain mix plus syrup at the

freezer, and gives a better flavored, more uniform product, freer of dark specks.

Freezing characteristics. Chocolate ice cream is one of the most difficult to freeze because it whips very slowly. This is due to the fact that chocolate mix is very viscous. The viscosity may be reduced and whipping time improved by adding one pound of sodium bicarbonate to 1,000 pounds of mix.

FRUITS IN ICE CREAM

The ice cream trade is one of the chief markets for fresh, frozen and canned (pie grade) fruits. Strawberry ice cream ranks third among flavors, being about 8 per cent of the total amount of ice cream made. Other fruit flavors are popular in season and are consumed more or less throughout the year.

Fruit flavors are available as (1) extracts prepared from the fruit, (2) artificial compounds, and (3) true extracts fortified artificially. These flavors supplement the fruits in cases where it is necessary to avoid excessive amounts of fruit, but they are quite generally inferior to the flavor obtained from the fruit itself and do not supply the desired fruit pulp.

A special mix need not be used for fruit ice cream unless the basic mix contains more than 16 per cent sugar. With a 16 per cent sugar content a 3:1 fruit pack should be used. If the mix contains 15 per cent sugar or less, the 2:1 pack is usually preferred.

Since fruit ice cream contains a higher percentage of sugar than plain ice cream it should be drawn from the freezer at about 1° F. colder. A drawing temperature of 23° F. is satisfactory under most conditions.

Fresh fruit must be considered the best source of flavor when available at sufficiently low prices. Fresh fruit ice creams also have a special sales appeal. The fruit should be washed and hulled or peeled and then mixed with sugar in the ratio of 2:1 or 3:1 (*i.e.*, 2 lb. fruit to 1 lb. of sugar or 3 lb. fruit to 1 lb. sugar) and held at about 40° F. for 12 to 24 hours before using. During this aging period a large part of the juice and flavor of the fruit will combine with the sugar, by osmotic action, to form a fruit syrup. This syrup will impart to the ice cream the full flavor of the fruit much more effectively than would the fresh fruit used immediately. Strawberries need not be mashed or sliced. This is merely a waste of time and does not enhance their flavoring ability. Very seedy fruits such as raspberries should be pureed so that about ¾ of the seeds are removed. Peaches should be sliced.

Kind of pack to use. Fresh or frozen packs are preferable for fruits such as strawberries whose distinctive flavor is easily impaired by heating; while fruits like cherries or pineapple, whose flavors are relatively stable or improved by heating, are usually heat-preserved, that is, canned. For straw-

berries the 2:1 and 3:1 frozen packs are the most popular, with the tendency toward the latter. Peaches should also be frozen, the 3:1 pack being preferred. Raspberries are very satisfactory frozen, although they withstand heating much better than strawberries. Cherries are usually canned although the frozen fruit is satisfactory. The 2:1 ratio pack should be used in both cases. Generally the maraschino process cherries are used. Frozen pineapples are used occasionally and have a very fine flavor but the canned fruit flavor is also very popular.

The amount of fruit required to impart the desired flavor varies with the characteristic intensity of the flavor. This amount varies from 10 to 20 per cent of the weight of the finished product. In every case fruit ice cream should contain not less than 3 per cent by weight of clean, mature, sound fruits or the juice thereof. This minimum value is desirable and is already a legal requirement in some states. It is usually desirable also to have pieces of the fruit or pulp large enough so they can be easily recognized in the finished ice cream.

For strawberries the optimum amount seems to be about 15 per cent of 2:1 or 3:1 pack. For cherry ice cream, as well as pineapple, 12 to 15 per cent is satisfactory. When these fruits are high in price, less fruit is often used, and enough true fruit extract added to produce a flavor approximately the same as the natural fruit flavor. A little artificial color is added to give the delicate tints associated with these fruits. Raspberries are generally rather expensive so about 10 per cent of fruit plus enough good raspberry extract to bring out the desired flavor should be used. For best results with peaches about 20 per cent of frozen pack fruit should be used along with a good peach brandy syrup. Of the mixed fruits and fruit combinations, about 15 per cent seems to be the desirable amount to use.

Candied or Glacéd fruits such as cherries, pineapple, and citron, and such candied fruit peels as orange, lemon, and grapefruit are very good flavoring materials. They are used chiefly in rich types of ice cream—puddings, aufaits, mousses—and as decorative material for fancy molded ice creams, and sherbets and ices.

Dried fruits such as apricots, figs, prunes and raisins make tasty ice creams. Although of slightly different flavor than the corresponding fresh fruit, they usually are less expensive and often can be obtained at times when fresh fruit is very scarce or in places where it is practically unobtainable. Dates, figs, and raisins, particularly, have long been used in frozen puddings, but recently there has been a tendency to use these and other dried fruits as flavoring material for ice cream either separately or in combinations.

NUTS

Nut meats and nut extracts are quite extensively used as flavorings in ice cream. Pecans, walnuts, almonds, pistachio, filberts, and peanuts are among the most popular. Nut meats should be sound and clean and free from rancid flavors. They should be stored in tight containers in a cool place until used. Considerable care should be used in preparing them for the ice cream mix, to make certain that no foreign material, such as pieces of shell or pieces of wood and nails from containers, get into the mix. Some nuts such as almonds, filberts, and pistachios should be blanched to remove their dark outer skin.

Since nut meats are often high in bacteria count and sometimes are not hygienically handled, they may contaminate the mix and be the source of high count and sometimes pathogenic bacteria count in the ice cream unless they receive special heat treatment. Some manufacturers dry-heat the nuts to pasteurizing temperatures or above, while others have found that they can greatly reduce bacterial count, and improve the flavor of some nut meats, by dipping them in a boiling, slightly salted sugar solution for a few seconds. To prevent sogginess, the meats are afterwards dried for 3 or 4 minutes at 250° to 300°F. All nut meats should be chopped into very small pieces before they are added to the mix.

SPICES AND SALT

Spices such as cinnamon, cloves, nutmeg, allspice, and ginger are used to a limited extent as flavorings in ice cream, sherbets, and ices. Ginger ice cream is a favorite in some localities. Cinnamon, nutmeg, or cloves are often used to enhance or vary the flavor of chocolate ice cream, and they are used in combination with fruits or fruit extracts in such frozen products as puddings, eggnog, and punch.

Spices may be purchased either in dried and finely ground form or as extracts. Their flavors are very pungent and therefore only small amounts are required to produce the desired flavoring effect.

Salt, although not a spice, is often used in very small quantities to enhance the flavor of ice creams, especially in mixes containing eggs—custards and rich puddings—and in nut ice cream.

COLOR IN ICE CREAM

Ice cream should have a delicate, attractive color which suggests or is readily associated with the flavor. Only colors certified by the Food and Drug Administration of the United States Department of Agriculture should be used.

Almost all flavors of ice cream should be slightly colored. Enough yellow

color is generally added to vanilla ice cream to give it the shade of natural cream produced in the summer months. Fruit ice creams need to be colored because about 15 per cent of fruit, the maximum commonly used, produces only a slight effect on color. Chocolate ice cream is one of the exceptions. It rarely needs to be colored, for the required amount of a Dutch processed cocoa will produce sufficient color.

Most Colors are of Chemical Origin. A weak alkaline solution annatto color is about the only vegetable color used in ice cream. However, this does not produce a good egg-shade yellow, but rather a pinkish tinge. Therefore the bulk of colors used are chemical in origin. Most ice cream makers purchase the desired colors in liquid or paste form.

Preparation of Coloring Solutions. It is more economical to purchase food colors in powder form and dissolve them in boiling water as needed. Blending of these "primary colors" to give desired shades requires some artistic ability and experience. Such coloring solutions if contaminated will become very high in bacteria count. In this way the bacteria content of the ice cream is increased and the growth of the organisms partially destroys the color pigment. Therefore color solutions should not be prepared in large amounts, should be boiled, and should be stored in a cool place. A good practice is to add 0.1 per cent of sodium benzoate to the solution to keep it sterile.

Permitted Coal-Tar Food Colors. The following coal-tar dyes are now accepted for certification as described on pages 4 to 6 of Service and Regulatory announcements, Food and Drug No. 3:

Red shades:
- 80. Ponceau 3R
- 184. Amaranth
- 773. Erythrosine
- Ponceau SX

Green shades:
- 666. Guinea Green B
- 670. Light green SF Yellowish
- Fast green FCF

Blue shades:
- 1180. Indigotine

Orange shades:
- 150. Orange I

Yellow shades:
- 10. Naphthol Yellow S
- 640. Tartrazine
- 22. Yellow AB
- 61. Yellow OB
- Sunset Yellow FCF

The numbers preceding the names refer to the colors as listed in the Colour Index published in 1924 by the Society of Dyers and Colourists of England, which gives the composition of these dyes. Names not preceded by numbers are not listed in the Colour Index. The composition of such dyes will be furnished on application to the Food and Drug Administration.

CHAPTER VIII

CALCULATION OF ICE CREAM MIXES

The Importance of Calculations. Since the palatability, quality, body and texture, and cost of the ice cream hinges upon the ice cream maker's ability to select and use, in the right proportion, the various ingredients from those that are available, it becomes highly desirable for him to learn to calculate accurately the amount of each ingredient that goes into the mix that he desires to make. In other words the ice cream maker needs to know the answer to such questions as: How much does it cost to make a gallon of ice cream? How much ice cream can be made from a gallon of mix? How much cream, sugar, *etc.,* are needed to make 100 lb. (or any other number of lb.) of mix? Answers to such questions can be obtained only if he has the "know how" to make at least simple, although time-consuming, calculations.

A knowledge of calculations is also helpful in properly balancing a mix, and especially in establishing and maintaining uniform quality, and in producing ice cream that conforms to the necessary legal standards. Some authorities think that the ice cream maker's knowledge concerning the making of ice cream is in direct proportion to his ability to make the necessary calculations.

The method and procedure of making calculations are demonstrated by a few typical problems. These demonstrations are presented in detail for the benefit of the reader who might be confused by figures alone—*i.e.,* without explanation of the processes involved. However the presentation here attempts to focus attention on **the method** and **the procedure** with a minimum of effort in performing the necessary arithmetic. It is assumed that the reader is most interested in learning a quick and easy way to arrive at the correct answer and therefore little explanation is given of the mathematics involved in deriving the formulas or the logic in setting up the equations.

Much practice is usually necessary to develop speed and accuracy in making calculations. This practice can be obtained by using the demonstrated problems as a pattern for setting up and solving many similar problems.

MATHEMATICAL PROCESSES MOST FREQUENTLY USED.

Briefly the discussion in this chapter on calculating ice cream mixes, assumes a knowledge of arithmetic, especially decimals and percentages. Even so, it may be helpful to state the following *mathematical facts* that will be used frequently:

1. A fraction indicates the process of division. Thus:

$\frac{2.25}{5}$ means that 2.25 is divided by 5 to give 0.45,

or $\frac{2.25}{5} = 2.25 \div 5 = 0.45$;

and $\frac{2.25}{94\%}$ indicates that 2.25 is divided by 0.94,

or $\frac{2.25}{94\%} = 2.25 \div 0.94 = 0.0239$;

and $\frac{63}{100\%}$ indicates that 63 is divided by 1.00,

or $\frac{63}{100\%} = 63 \div 1.00 = 63$

2. When a percentage figure is used in division or multiplication, the per cent sign is dropped and the decimal point is moved two places to the left. Thus, 10% becomes 0.10, 25.5% becomes 0.255, and so on.

3. When the lb. of milk (or cream) and the test are given, the lb. of fat are obtained by multiplication, thus:

$$50 \text{ (lb. milk)} \times 4\% \text{ (fat)} = 50 \times .04 = 2.00 \text{ lb. fat.}$$

4. When the lb. of fat and the test are given the lb. of milk (or cream) are obtained by division, thus: $\frac{2.00 \text{ lb. fat}}{4\%} = 50 \text{ lb. milk.}$

5. When the lb. of fat and the lb. of milk (or cream) are given the test is obtained by division, thus: $\frac{2.00 \text{ lb. fat}}{50 \text{ lb. milk}} = 0.04 \text{ or } 4\%$

This chapter also contains certain abbreviations and terms, some of which are widely accepted, while others are new and are introduced here for the sake of brevity and convenience. The following abbreviations are widely accepted:

ABBREVIATIONS AND SPECIAL TERMS

lb.—pound or pounds

serum—that portion of the mixture containing the water and milk solids not fat.

s.s.—serum solids—the moisture-free milk solids not fat—includes protein, lactose, and minerals.

stab.—stabilizer

t.s.—total solids—moisture-free—, and not to be confused with dried products such as powdered milk, cocoa or gelatin, all of which contain some moisture, in spite of their dry appearances.

s.n.f.—solids not fat.

The new and less common terms or abbreviations used herein are:

"conski"—plain condensed skim milk containing no added sugar and not superheated.

"egoso"—egg yolk solids—moisture-free egg yolk, and not to be confused with commercial dried egg yolk or egg yolk powder.

"skipo"—"skim milk powder," "powdered skim milk," *etc.,* which are now officially termed "nonfat dry milk solids."

"suconski"—sweetened condensed skim milk.

"sufect"—sweetening effect (see p. 19)

DECIDE ON ESSENTIALS OF MIX

Before a mix can be calculated it is necessary first to decide upon the composition desired in the finished product, *i.e.,* the percentage fat, serum solids, sufect, stabilizer, and egg yolk solids. Second, the amount of mixture, generally referred to as "mix," to be made at one time is also important and this is usually fairly constant in any one factory. However, it is often more convenient to calculate the amount of each ingredient needed to prepare 100 lb. of finished product, and these amounts can then readily be increased proportionately for larger batches. The third decision concerns the choice of ingredients that are available and the composition of each ingredient. Approximate compositions are found in Table 12, but accurate results can best be obtained when the calculations are based on the exact analysis of the ingredients actually used in making the ice cream. The relation of cost to quality desired should also be considered. The above information needed before a mix can be calculated can be briefly summarized as follows:

1. Decide upon composition of the mix to be made.
2. Decide on amount of mix in the batch to be made at one time. Whatever the amount, it may be calculated on the basis of 100 lb. if so desired.
3. Choose from the available ingredients those that will give the desired quality, characteristics, and composition at lowest cost.
4. Be familiar with the composition (*i.e.* the analysis) of ingredients to be used. See Table 12, page 75.

When the above information has been obtained, the mix can be classified either as a *simple mix* or a *complex mix* and calculations can be made accordingly.

SIMPLE MIXES

Simple mixes require the least calculation and include such mixes as one made of stabilizer, sugar, and cream; or one made from ingredients each of which supply only one constituent. Mixes having two sources of one constituent are more complex, but sometimes the calculation may be reduced to

the same simple procedure which is used for the simplest mixes. Problem 1 illustrates this point. It appears to be complex but is calculated by the same procedure and steps that would be used in calculating the simplest mixes.

PROBLEM 1:

How much 30% cream, skipo (skim milk powder) testing 97% s.s. (serum solids), cane sugar, dried egg yolk, gelatin, and water will be needed to make 450 lb. of mix testing 10% fat, 11% s.s., 14% sufect (sweetening effect), 0.5% egoso (egg yolk solids), and 0.5% stablizer?

SOLUTION:

Step 1. List the available ingredients and the number of pounds of each constituent in the desired mix, thus:

available ingredients	desired mix
gelatin 90% t.s.[a]	fat, 10% of 450 lb.=45 lb.
dried egg yolk, 62.5% fat. 94% t.s.	s.s., 11% of 450 lb.=49.5 lb.
cane sugar, 100% sufect	sufect, 14% of 450 lb.=63 lb.
skipo, 97% t.s., 97% s.s.	egoso, 0.5% of 450 lb.=2.25 lb.
cream, 30% fat, 6.24% s.s.	[b]stab., 0.5% of 450 lb.= 2.25 lb.
water	

Step 2. If desired, make a proof sheet as on page 61, and enter the "weight" and "percentage" of each constituent of the desired mix in their respective columns, (from step 1). Enter the information obtained in each succeeding step. (See completed proof sheet, page 59).

Step 3. Compute the amount of each ingredient which supplies only one constituent. In this problem that will be the gelatin, supplying all of the stabilizer; and the cane sugar, supplying all of the sufect.

The gelatin contains 90% t.s., and therefore 90% of the number of lb. of gelatin needed must equal 2.25 lb., the desired amount of stabilizer (the moisture-free part of the gelatin). From this it follows that:

$\frac{2.25}{0.90}$ =2.50 lb. gelatin needed. Enter 2.50 in weight column of proof sheet and enter 2.25 in the stab. and the t.s. columns. Cane sugar is 100% sufect, and so $\frac{63}{1.00}$ =63 lb. cane sugar needed. Enter this figure (63) in the wt., sufect, and t.s. columns of the proof sheet.

Step 4. Compute the amount of those ingredients which supply more than one constituent of the mix but which are the only remaining source of some one constitutent—in this problem, the dried egg yolk which is the only source of egoso.

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[a] The composition of the ingredients is preferably obtained from laboratory analyses, but approximate figures are available in table 12 on page 75.

[b] stabilizer in these calculations, means the moisture-free part of the gelatin or other sources of stabilizer

lb. dried egg yolk needed $= \frac{2.25 \text{ lb.}}{94\%} = 2.39$ lb. Enter in proof sheet.

Enter 2.25 lb. in the "egoso" and "t.s." columns of proof sheet. Also calculate the amount of other constituents supplied by the dried egg yolk, namely fat.

$$2.39 \text{ lb.} \times 62.5\% = 1.49 \text{ lb. fat. Enter in proof sheet.}$$

This 1.49 lb. of fat is part of the 2.25 lb. of egoso, or total solids. Frequently the fat supplied by the eggs is disregarded, but sometimes, as in this problem, it is considered as a part of the fat which is desired in the mix. Thus the 45 lb. of fat desired less the 1.49 lb. of fat supplied by the dried egg yolk leaves 43.51 lb. of fat to be supplied by other ingredients, in this case, the cream.

Hence the lb. 30% cream needed $= \frac{43.51 \text{ lb.}}{30\%} = 145.03$ lb. Enter in proof sheet. This cream furnishes not only fat but also serum solids, and the amount of the latter is computed as follows:

145.03 lb. 30% cream $\times$ 6.24% $=$ 9.05 lb. s.s. Enter in proof sheet.

The total 49.5 lb. of s.s. desired less the 9.05 lb. s.s. supplied by the cream leaves 40.45 lb. of s.s. to be obtained from the remaining ingredients, namely the skipo. Therefore it follows that:

$\frac{40.45 \text{ lb. s.s.}}{97\%} = 41.70$ lb. skipo needed. Enter in proof sheet. Enter 40.45 lb. in s.s. and t.s. columns of proof sheet.

Finally, the above calculated amounts of each ingredient are totaled, and this sum is subtracted from the total 450 lb. of mix desired. The difference represents the amount of water needed, thus:

$$450-(2.5 + 63 + 2.39 + 145.03 + 41.70)$$
$$= 450-254.62 = 195.38 \text{ lb. of water needed. Enter in proof sheet.}$$

Step 5. At this time it may also be desirable to compute the cost of the mix by entering in the proof sheet the actual cost of each ingredient. Problem 9, page 94, demonstrates how the cost of the ingredients used in Problem 1 is calculated. Cost figures are assumed, not actual.

Step 6. Find the percentage (test) of each constituent in the mix. If a proof sheet is used, each column should now be totaled. The calculated test for any constituent is obtained by dividing the total of that column by the total weight of the ingredients. For example, the calculated s.s. test is obtained by dividing 49.50 lb. s.s. (the total of the column "s.s. lb.") by 450 lb., the total weight of the ingredients, giving the answer 11.0%. Similarly 160.51 lb., the total of the column "t.s. lb.," is divided by 450 lb., the total weight of the ingredients, to give 35.67% t.s. In similar manner find the %

of each of the remaining constituents, and enter the figures in their respective columns in proof sheet.

Step 7. Determine the accuracy of the calculation from the proof sheet by comparing the "calculated %" for each constituent with the corresponding desired test. When the difference between these two percentages is less than one-tenth, the mix is assumed to be correctly calculated.

The completed proof sheet appears as follows:

Ingredients used	*Weight lb.*	*Calculated constituents*						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	2.50					2.25	2.25	
dried egg yolk	2.39	1.49			2.25		2.25	
cane sugar	63.00			63.00			63.00	
cream	145.03	43.51	9.05				52.56	
skipo	41.70		40.45				40.45	
water	195.38							
Total lb.	450.0	45.0	49.5	63.00	2.25	2.25	160.51	
Calculated %		10%	11%	14%	0.5%	0.5%	35.67%	
Check with desired wt.	450	45	49.5	63	2.25	2.25		
and %		10%	11%	14%	0.5%	0.5%		

COMPLEX MIXES

Complex mixes, according to our classification, include all mixes, except those classed as simple mixes, and mixes made in a vacuum pan. They can usually be identified by the fact that at least one constituent is obtained from two or more ingredients. These complex mixes are most rapidly calculated by using formulas in the following steps:

1. List the available ingredients and the number of pounds of each constituent of the desired mix.

2. Make a proof sheet as on page 61, and enter in it the information obtained in Step 1. Also enter the information obtained in each succeeding step.

3. Compute the amount of each ingredient which is the only source of some one constituent of the mix, and enter this in the proof sheet. This usually includes the stabilizer, egg products, and sugar substitutes.

4. Calculate the needed amount of condensed or powdered dairy product by either formula No. I or No. II.

5. Calculate the amount of sugar needed.

6. Calculate the needed amount of cream, or butter by formula No. III.

7. Calculate the needed amount of sweet whole milk or sweet skim milk.

8. Total each column and compute the "calculated %," especially the total solids test.

9. Examine for accuracy, by comparing with weights and percentages in the desired mix.

10. Compute the cost of the mix, if desired.

FORMULAS FOR CALCULATING COMPLEX MIXES

FORMULA No. I [a]

To find lb. of $\left\{\begin{matrix}\text{skipo or}\\ \text{of conski}\end{matrix}\right\}$ when using sweet whole milk or skim milk.

$$\frac{\text{lb. s.s. needed}-(\text{lb. serum}^{b}\text{ of mix}\times 0.09^{c})}{\text{b. s.s. in 1 lb. skipo}^{d}-0.09^{c}} = \text{lb. skipo}^{d}$$

[a] Although this formula is not absolutely accurate when butter is the source of fat, it gives results that are sufficiently accurate for practical operation.

[b] serum of mix= lb. of mix — sum of lb. fat, gelatin, egg and sufect source.

[c] This figure represents the % total solids in 1.00 lb. of skim milk in this case, 9.0%. However if skim milk tests 8.8% total solids, then for accurate calculation the figure used would be 0.088.

[d] Conski can be substituted for skipo.

FORMULA No. II

To find lb. of $\left\{\begin{matrix}\text{condensed whole milk}\\ \text{or of suconski}\end{matrix}\right\}$ when using sweet whole milk or skim milk.

$$\frac{\text{lb. s.s. needed}-(\text{lb. serum}^{b}\text{ of mix}\times 0.09^{c})}{\text{lb. s.s. in 1 lb. condensed}-(\text{lb. serum in 1 lb. condensed}\times 0.09^{c})} = \text{lb. condensed needed}$$

[b] (see above)

[c] (see above)

FORMULA No. III

To find lb. of cream needed when using sweet whole milk. This same formula may be used to find the lb. of butter needed if the word "butter" is substituted for the word "cream" in the formula.

$$\frac{\text{lb. fat needed}^{a}-(\text{lb. milk and cream needed}^{b}\times\%\text{ fat in milk})}{\text{lb. fat in 1 lb. cream}-\text{lb. fat in 1 lb. milk}} = \text{lb. cream needed.}$$

[a] lb. fat needed=lb. fat in the milk needed plus lb. fat in the cream needed.

[b] lb. milk and cream needed=lb. mix—sum of lb. of all ingredients except milk and cream.

Sample Proof Sheet

Ingredients used	*Weight lb.*	Calculated constitutents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
Total lb.								
Calculated %		%	%	%	%	%	%	
Check with desired wt.								
and %		%	%	%	%	%	%	

This proof sheet is useful in calculating the mix and especially helpful in examining the accuracy of the calculations.

PROBLEM 2: IN WHICH THE SERUM SOLIDS ARE OBTAINED FROM THREE SOURCES.

Calculate the amount of ingredients needed to make 200 lb. of mix testing 14% fat, 9% s.s., 13% sufect, and 0.5% stabilizer. The available ingredients are 40% cream, 4% milk, conski (27% s.s., 27% t.s.), cane sugar, and gelatin.

SOLUTION:

This is a complex mix since the serum solids will be obtained from three sources (conski, cream, and milk). Therefore it is most rapidly calculated by using formulas No. I and No. III.

Step 1:

available ingredients	**desired mix**
gelatin, 90% t.s.[a]	fat, 14% of 200 lb.=28 lb.
cane sugar, 100% sufect	s.s, 9% of 200 lb.=18 lb.
conski, 27% t.s., 27 s.s.	sufect, 13% of 200 lb.=26 lb.
cream, 40% fat, 5.35% s.s.	stab., 0.5% of 200 lb.=1 lb.
milk, 4% fat, 8.79% s.s.	

Step 2: Make proof sheet and enter information from step 1.

Step 3: In this problem, gelatin is the only source of stabilizer, and it contains 90% t.s., the balance being water. Therefore 90% of the number of lb. gelatin needed must equal 1.0 lb., the desired amount of stabilizer It follows that $\frac{1.0}{0.90}$ =1.11 lb., the amount of gelatin needed. This figure (1.11) is entered in the weight column of the proof sheet.

[a] The composition of the ingredients is preferably obtained from laboratory analyses, but approxima figures are available in Table 12 on page 75.

Since the gelatin contains 1 lb. stabilizer which is also 1 lb. total solids —enter these figures in the stab. and t.s. columns respectively.

In this problem, no egg products are used and no sugar substitutes are used, therefore, these require no calculation.

Also, in this problem, cane sugar happens to be the only source of sufect, therefore, it can be calculated either here or in step 5.

Step 4: To find the amount of conski needed, it will be necessary to use formula No. I. The figures to substitute in the formula are obtained as follows:

lb. s.s. needed=18 lb. (from proof sheet or step 1)

lb. serum of mix = 144.89 lb., obtained by calculation as follows:

first find the sum of: 28. lb. fat (from step 2)
1.11 lb. gelatin (from step 3)
26. lb. sufect source since it is all sucrose —— (from step 2)
55.11 lb. total

then subtract this 55.11 lb. from the desired total weight of the mix, in this problem, 200 lb. This leaves 144.89 lb., the amount of serum of the mix.

lb. s.s. in 1 lb. conski=0.27, obtained by multiplying the 1.0 lb. by 27% which is the s.s. test.

These figures are substituted in formula No. I to give:

$$\frac{\text{18 lb. s.s. needed}-(\text{144.89 lb. serum}\times 0.09)}{0.27-0.09} = \text{lb. conski needed}$$

The formula is solved by making the computations, thus:

$$\frac{\text{18 lb.}-(\text{144.89 lb.}\times 0.09)}{0.27-0.09} = \frac{18-13.05}{0.27-0.09} = \frac{4.95}{0.18} = 27.5 \text{ lb. conski needed.}$$

This figure is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. s.s. and the lb. t.s. supplied by the 27.5 lb. conski. They are obtained by multiplication as follows:

$27.5 \times 27\%$ s.s.=7.425 lb. s.s.

$27.5 \times 27\%$ t.s.=7.425 lb. t.s.

Step 5: To calculate the amount of sugar needed, divide the remaining lb. of sufect by the % sufect in the sugar. In this problem all of the 26 lb. of sufect remain to be furnished by cane sugar, since there is only one source of sufect. Therefore, it follows that $\frac{26}{1.00} = 26$, the lb. of sugar needed. This can be entered in the proof sheet under weight, sufect, and t.s. because cane sugar is practically 100% t.s.

Step 6: The amount of cream needed is calculated with the aid of formula III. The figures to substitute in the formula are obtained as follows:

lb. fat needed=28 (from step 2)

lb. of milk and cream needed=145.39 lb., calculated as follows:

first find the sum of: 1.11 lb. gelatin (step 3)
27.50 lb. conski (step 4)
26.00 lb. sugar (step 5)

54.61 lb. total

then subtract 54.61 lb. from the desired total weight of the mix, 200 lb., which leaves 145.39 lb., the amount of milk and cream needed.

lb. fat in 1 lb. of 40% cream=0.40 obtained by multiplication:

1 lb. cream × 40% fat = 0.40 lb. fat.

lb. fat in 1 lb. of 4% milk = 0.04 obtained by a similar multiplication.

These figures are substituted in the formula to give:

$$\frac{28 \text{ lb.}—(145.39 \text{ lb. x } 4\%)}{0.40—0.04} = \text{lb. 40\% cream needed.}$$

In the process of solving, the formula becomes

$$\frac{28 \text{ lb.}—5.820 \text{ lb.}}{0.36} = \frac{22.180}{0.36} = 61.61, \text{ lb. 40\% cream needed.}$$

This (61.61 lb.) is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. of fat, s.s., and t.s. which are contained in the 61.61 lb. of cream.

61.61 lb. × 40%=24.644 lb. fat

61.61 lb. × 5.35%=3.296 lb. s.s.

24.644 lb. plus 3.296 lb.=27.940 lb. t.s.

Step 7: The lb. of milk needed are computed by subtraction thus:

145.39 lb. milk and cream needed (from step 6)
less 61.61 lb. cream needed (from step 6)

leaves 83.78 lb. milk needed.

This (83.78 lb.) is entered in the weight column of the proof sheet, and also the lb. fat, lb. s.s., and lb. t.s. are entered in their respective columns.

83.78 lb. × 4%=3.351 lb. fat

83.78 lb. × 8.79%=7.364 lb. s.s.

3.351 lb. fat plus 7.364 lb. s.s.=10.720 lb. t.s.

Step 8. Each column of the proof sheet is now totaled and these totals should agree with the corresponding figure of the desired mix. In other words, the total weight of all ingredients should equal the desired weight of the mix, the total fat supplied by all ingredients should equal the fat desired in the mix, and so on. However, if the decimals are not carried far enough, these totals may sometimes be slightly higher or slightly lower than the corresponding figure of the desired mix. This apparent error may be insignificant, as shown by step 9.

The total solids test is computed by division, thus:

$$\frac{73.09 \text{ lb. t.s.}}{200 \text{ lb. mix}} = 0.3655 \text{ or } 36.55\% \text{ t.s.}$$

Similar divisions will compute the calculated % for each of the constituents, thus:

$$\frac{18.09 \text{ lb. s.s.}}{200 \text{ lb. mix}} = 0.0905 \text{ or } 9.05\% \text{ s.s.}$$

Step 9: The accuracy of the calculations may be determined by comparing the calculated % for each constituent with the corresponding test of the desired mix. For example: in this problem, the calculated % of s.s. is 9.05% (see step 8), which is compared with the 9.0% s.s. of the desired mix. Since the difference between these two percentages is less than 0.1, it is not significant. Similar comparisons for each constituent show no significant differences, and therefore the calculations are correct.

Step 10: Since the actual cost depends upon many factors, the figures are not included in this problem but the methods of calculating an assumed cost is demonstrated in problem 9, page 94.

The completed proof sheet appears as follows:

Ingredients Used	*Weight lb.*	Calculated constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egosa lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	1.11					1.00	1.00	
cane sugar	26.00			26.00			26.00	
conski	27.50		7.43				7.43	
cream	61.61	24.64	3.30				27.94	
milk	83.78	3.35	7.36				10.72	
Total lb.	200.00	27.99	18.09	26.00		1.00	73.09	
Calculated %		14%	9.05%	13%	%	0.5%	36.55%	
Check with desired wt. and %	200 [a]	27.99	18.00	26		1.00		
		14%	9.0%	13%		0.5%		

[a] includes the lb. t.s. and water which sometimes can be correctly stated only after calculating the mix.

PROBLEM 3: IN WHICH THERE IS MORE THAN ONE SOURCE OF SUFECT, S.S., AND FAT

Calculate the amount of ingredients needed to make 900 lb. of mix testing 12% fat, 10% s.s., 14% sufect, and 0.4% stabilizer. The available ingredients are 40% cream, 4.0% milk, Frodex to supply ¼ of the sufect, suconski (42% sugar, 30% s.s.), cane sugar and gelatin.

SOLUTION:

This complex mix has three sources of sufect, three sources of serum solids and two sources of fat. Therefore the calculations will be made by formulas No. II and No. III.

Step 1:

available ingredients	**desired mix**
gelatin, 90% t.s.	fat, 12% of 900 lb.=108 lb.
Frodex, 47% sufect, 96.5% t.s.	s.s., 10% of 900 lb.=90 lb.
suconski, 42% sufect, 30% s.s.	sufect, 14% of 900 lb.=126 lb.
cane sugar	stab., 0.4% of 900 lb.=3.6 lb.
cream, 40% fat[1]	
milk, 4% fat	

Step 2: Proof Sheet:

Ingredients Used	*Weight lb.*	Calculated constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin								
Frodex								
suconski								
cane sugar								
cream								
milk								
Total lb.								
Calculated %		%	%	%	%	%	%	
Check with desired wt.	900[a]	108	90	126		3.6		
and %		12%	10%	14%	%	0.4%	%	

[a] includes the lb. t.s. and water which sometimes can be correctly stated only after calculating the mix.

Step 3: In this problem gelatin is the only source of stabilizer, and as previously stated it contains 90% t.s. Therefore, 90% of the number of lb. needed equals 3.6 lb., the desired amount of stabilizer, (from Step 1). It follows that $\frac{3.6 \text{ lb.}}{0.90} = 4.0$ lb. gelatin needed. This figure (4.0) is entered in the

[1] When percentage composition of ingredients is not given, use data from table 12 on page 75.

weight column of the proof sheet. Enter 3.6 lb. in the stab. column of the proof sheet, and also in the t.s. column.

Since no egg products are used in this mix, no calculations are necessary.

Frodex, corn syrup solids, is used to supply one fourth of the desired sufect. Therefore $\frac{126 \text{ lb. sufect}}{4} = 31.5$ lb. sufect to be obtained from Frodex which contains only 47% sufect. It follows that $\frac{31.5 \text{ lb. sufect}}{0.47} = 67.02$ lb., the amount Frodex needed.

This figure (67.02) is entered in the weight column of the proof sheet. Enter the 31.5 lb. of sufect in the sufect column. Multiplying, 67.02 lb. × 96.5% (% t.s. in Frodex) gives 64.67 lb. total solids to enter in the t.s. column of the proof sheet.

Step 4: To find the amount of suconski needed, use formula No. II. The figures to substitute in the formula are obtained as follows:

lb. s.s. needed=90 lb. (from proof sheet or step 1)

lb. serum of mix=626.48 lb., obtained by calculations as follows:

first find the sum of:

108.0 lb.	fat (step 1 or 2)
4.0 lb.	gelatin (step 3)
67.02 lb.	Frodex (step 3)
94.50 lb.	sufect not supplied by Frodex (126 lb.—31.5 lb.=94.50 lb.)
273.52 lb.	total

then subtract 273.52 lb. from the desired total weight of the mix: 900—273.52=626.48 lb. serum of the mix.

lb. s.s. in 1 lb. condensed=0.30, obtained by multiplying the 1 lb. by 30% (the s.s. test).

lb. serum in 1 lb. condensed=0.58 lb. obtained by calculation as follows: first multiply 1 lb. suconski by 42% sugar to get 0.42 lb. sugar. Then subtract the 0.42 lb. from the 1 lb. suconski. This leaves 0.58 lb. serum which includes only the water and s.s. in the 1 lb. suconski.

These figures are substituted in formula No. II thus:

$$\frac{90 \text{ lb. s.s.}—(626.48 \text{ lb.} \times 0.09)}{0.30—(0.58 \times 0.09)} = \text{lb. suconski needed}$$

The formula is solved by making the computations, thus:

$$\frac{90 \text{ lb.}—(626.48 \text{ lb.} \times 0.09)}{0.30—(0.58 \times 0.09)} = \frac{90—56.383}{0.30—0.052} = \frac{33.617}{0.248} = 135.55 \text{ lb. suconski needed.}$$

This figure (135.55) is entered in the weight column of the proof sheet. Also, enter in their respective columns of the proof sheet, the lb. s.s., lb. sufect, and lb. t.s., which the 135.55 lb. suconski contain. These are obtained by multiplication as follows:

135.55 × 30% s.s.=40.665 lb. s.s.
135.55 × 42% sufect=56.93 lb. sufect
135.55 × 72% t.s.=97.60 lb. t.s.

Step 5: To calculate the amount of sugar needed, divide the remaining lb. of sufect by the % sufect in the sugar. In this problem, a total of 126 lb. of sufect is desired, and in step 3 Frodex was calculated to supply 31.5 lb. of this sufect. Also in step 4, the suconski was found to furnish 56.93 lb. of sufect, making 88.43 lb. of sufect supplied by the Frodex and the suconski. Subtracting the 88.43 lb. from the 126 lb. leaves 37.57 lb. to be obtained from cane sugar which is 100% sufect. Therefore it follows that $\frac{37.57}{1.00}$ =37.57 lb. the amount of cane sugar needed. This figure can be entered in the proof sheet under weight, sufect, and t.s.

Step 6: The amount of cream needed is calculated with the aid of formula III. The figures to substitute in the formula are obtained as follows:

lb. fat needed=108 (from step 2)
lb. milk and cream needed=655.86 lb., obtained by calculation as follows:

first find the sum of:

4.0	lb. gelatin (step 3)
67.02	lb. Frodex (step 3)
135.55	lb. suconski (step 4)
37.57	lb. cane sugar (step 5)
244.14	lb. total

then subtract this 244.14 lb. from the 900 lb. desired weight of the mix. This leaves 655.86 lb., the amount of milk and cream needed.
lb. fat in 1 lb. cream=0.40, obtained by multiplying 1 lb. cream × 40%.
lb. fat in 1 lb. milk=0.04, obtained by a similar multiplication.

These figures are substituted in the formula to give:

$$\frac{108 \text{ lb.} - (655.86 \text{ lb.} \times 4\%)}{0.40 - 0.04} = \text{lb. } 40\% \text{ cream needed.}$$

In the process of solving, the formula becomes:

$$\frac{108 \text{ lb.} - 26.234 \text{ lb.}}{0.36} = \frac{81.766}{0.36} = 227.13 \text{ lb. } 40\% \text{ cream needed.}$$

This number is entered in the weight column of the proof sheet. Also enter in their respective columns in the proof sheet, the lb. fat, lb. s.s., and lb. t.s. which are contained in the cream, thus:

227.13 lb. × 40% fat=90.852 lb. fat
227.13 lb. × 5.35% s.s.=12.151 lb. s.s.
90.852 plus 12.151=103.00 lb. t.s.

Step 7: The lb. of milk needed are obtained by subtraction, thus:

655.86 lb. milk and cream (see step 6)

less 227.13 lb. cream (see step 6)

leaves 428.73 lb. milk needed

This 428.73 lb. is entered in the weight column of the proof sheet. Also enter in their respective columns in the proof sheet, the lb. fat, lb. s.s., and lb. t.s. contained in the milk.

428.73 lb. $\times$ 4% fat $=$17.149 lb. fat

428.73 lb. $\times$ 8.79% s.s.$=$37.685 lb. s.s.

17.149 plus 37.685$=$54.83 lb. t.s.

Step 8: Each column of the proof sheet is now totaled, and these totals should agree with the corresponding figure of the desired mix. In other words, the total weight of all ingredients should equal the desired weight of the mix, the total fat supplied by all ingredients should equal the fat desired in the mix, and so on. However, if the decimals are not carried far enough, these totals may sometimes be slightly higher or slightly lower than the corresponding figure of the desired mix. This apparent error may be insignificant as shown by Step 9.

The % total solids is computed by division, thus:

$$\frac{361.27}{900 \text{ lb. mix}} = 0.4014 = 40.14\% \text{ t.s.}$$

Similarly compute the percentages of the remaining constituents, thus:

$\frac{90.50 \text{ lb. s.s.}}{900 \text{ lb. mix}} = 0.1006 = 10.06\%$ s.s., and so on until the percentages for each constituent in the mix is calculated.

Step 9: The accuracy of the calculations may be determined by comparing the calculated % for each constituent with the corresponding test of the desired mix. For example, in this problem, the calculated % of s.s. is 10.06% (see step 8), which is compared with the 10% s.s. of the desired mix. Since the difference between these two percentages is less than 0.1, it is not significant. Similar comparisons for each constituent show no significant differences, and therefore, the calculations are correct.

Step 10: At this time it may be desirable to compute the cost of the mix by entering in the proof sheet the actual cost of each ingredient. Since the actual cost depends upon many factors, the figures are not included in this example.

The completed proof sheet appears as follows:

Ingredients Used	*Weight lb.*	Calculated constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	4.00					3.60	3.60	
Frodex	67.02			31.50			64.67	
suconski	135.55		40.67	56.93			97.60	
cane sugar	37.57			37.57			37.57	
cream	227.13	90.85	12.15				103.00	
milk	428.73	17.15	37.68				54.83	
Total lb.	900.00	108.00	90.50	126.00		3.60	361.27	
Calculated %		12%	10.06%	14%	%	0.4%	40.14%	
Check with desired wt.	900 [a]	108	90	126		3.60		
and %		12%	10%	14%	%	0.4%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

PROBLEM 4: IN WHICH LEFT-OVERS ARE USED.

A 900 lb. mix testing 12% fat, 10% s.s., 14% sufect, 0.5% egoso, and 0.3% stabilizer is desired. The following materials are "left-overs" to be used to avoid loss: 40 lb. frozen 50% cream, 90 lb. 30% cream, 25 lb. suconski (42% sufect, 28% s.s.), 100 lb. 3% milk, and 30 lb. sweetose.

The following ingredients are also available: gelatin, cane sugar, frozen egg yolk (33% fat, 50% t.s.), conski (32% t.s.), 40% cream, and 4% milk

SOLUTION:

This problem shows how to make use of "left-overs" or relatively small amounts of several ingredients. The procedure can also be used when there are several lots of cream none large enough to make the entire batch of mix.

Step 1:

available ingredients

frozen cream, 50% fat, 4.45% s.s.
cream, 30% fat, 6.24% s.s.
suconski, 28% s.s., 42% sufect
milk, 3% fat, 8.33% s.s.
sweetose, 67% sufect, 83% t.s.
gelatin, 90% t.s.
frozen egg yolk, 33% fat, 50% t.s.
cane sugar
conski, 32% s.s., 32% t.s.
cream, 40% fat, 5.35% s.s.
milk, 4% fat, 8.79% s.s.

desired mix

fat, 12% of 900 lb.=108 lb.
s.s., 10% of 900 lb.=90 lb.
sufect, 14% of 900 lb.=126 lb.
egoso, 0.5% of 900 lb.=4.50 lb.
stab., 0.3% of 900 lb.=2.70 lb.

Step 2: Proof Sheet.

Ingredients Used	*Weight lb.*	Calculated Constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
frozen cream								
30% cream								
suconski								
3% milk								
sweetose								
gelatin								
frozen egg yolk								
cane sugar								
conski								
40% cream								
4% milk								
Total lb.								
Calculated %		%	%	%	%	%	%	
Check with desired wt.	900 [a]	108	90	126	4.5	2.7		
and %		12%	10%	14%	0.5%	0.3%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

Step 3: Since there are several ingredients to be completely used, enter the amount of each of these immediately in the weight column of the proof sheet. Then compute the lb. of each constituent contained in each ingredient, and enter these amounts in their respective columns of the proof sheet. For instance, 40 lb. frozen cream multiplied by its fat test (50%) gives 20 lb. fat, and multiplied by its s.s. test (4.45%) gives 1.78 lb. s.s., and multiplied by its t.s. test (54.45%) gives 21.78 lb. t.s. Similar multiplications are made for the 30% cream, suconski, 3% milk, and sweetose.

When these data have been entered in the proof sheet it is apparent that no stabilizer has been obtained, and that 2.7 lb. is needed. In this problem gelatin is the only source of stabilizer, and it contains 90% t.s. It follows that $\frac{2.7 \text{ lb.}}{0.90}$=3.0 lb. gelatin needed. This figure (3.0) is entered in the weight column of the proof sheet. The 2.7 lb. of stalilizer is entered in the stab. column, and also in the t.s. column of the proof sheet.

Again referring to the partially completed proof sheet, it is apparent that 4.50 lb. of egoso must be obtained from the frozen egg yolk which is 50% t.s. and therefore 50% egoso. It follows that

$\frac{4.50 \text{ lb.}}{0.50}$=9.00 lb. the amount of frozen egg yolk needed. This figure (9.0) is entered in the weight column of the proof sheet. The following multiplications give the amount of each constituent furnished by the frozen egg yolk:

9.0 lb. × 33% fat=2.97 lb. fat

9.0 lb. × 50% egoso=4.50 lb. egoso

9.0 lb. × 50% t.s.=4.50 lb. t.s.

These amounts of fat, egoso, and t.s. are entered in their respective columns of the proof sheet.

Once again refer to the partially completed proof sheet. It now appears that all of the stabilizer and all of the egoso have been provided for. Also, it appears that the suconski and the sweetose will furnish 30.60 lb. of sufect leaving some to come from the cane sugar which is the only remaining source of sufect. By subtracting the 30.60 lb. from the desired 126 lb. leaves 95.40 lb. sufect to be obtained from cane sugar which is 100% sufect. It follows that $\frac{95.40 \text{ lb.}}{1.00}$=95.40 lb., the amount of cane sugar needed. This figure (95.40) is entered in the weight, the sufect, and t.s. columns of the proof sheet.

By adding each column as it now stands, it appears that provision has been made for 392.4 lb. total weight, 52.97 lb. fat, 22.73 lb. s.s., 126 lb. sufect, 4.50 lb. egoso, and 2.7 lb. stab. Subtracting each of these from its corresponding figures in the desired mix leaves 507.6 lb. total weight, 55.03 lb. fat, and 67.27 lb. s.s. These figures will be used in the following steps:

Step 4: To find the amount of conski needed, it will be necessary to use formula No. I. The figures to substitute in the formula are obtained as follows:

lb. s.s. needed = 67.27 (see end of step 3)

lb. serum of mix=452.57 lb., obtained by subtraction as follows:

507.60 lb. total weight
less 55.03 lb. fat
leaves 452.57 lb. serum

lb. s.s. in 1 lb. conski=0.32, obtained by multiplying 1 lb. by 32% which is the s.s. test.

These figures are substituted in the formula, thus:

$$\frac{\text{67.27 lb. s.s.}-(\text{452.57 lb.} \times 0.09)}{0.32-0.09}=\text{lb. conski needed}$$

The formula is solved by making the computations, thus:

$$\frac{67.27-(452.57\times 0.09)}{0.32-0.09}=\frac{67.27-40.73}{0.23}=\frac{26.54}{0.23}=115.39 \text{ lb. conski needed.}$$

Therefore 115.39 lb. conski is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. s.s. and the lb. t.s. which are contained in the conski. These are obtained by multiplication as follows:

115.39 lb. × 32% s.s.=36.92 lb. s.s.

115.39 lb. × 32% t.s.=36.92 lb. t.s.

Step 5: The amount of sugar was calculated as part of Step 3.

Step 6: To find the amount of cream needed, it will be necessary to use formula No. III. The figures to substitute in the formula are obtained as follows:

lb. fat needed=55.03 (see end of step 3)

lb. milk and cream needed=392.91 lb., obtained by subtraction as follows:

507.60 lb. total weight
less 115.39 lb. conski
leaves 392.91 lb. milk and cream

lb. fat in 1 lb. cream=0.40, obtained by multiplying 1 lb.×40%=0.40 lb. fat.

lb. fat in 1 lb. milk=0.04, obtained by a similar multiplication.

These figures are substituted in the formula, thus:

$$\frac{55.03 \text{ lb. fat} - (392.21 \text{ lb.} \times 4\%)}{0.40 - 0.04} = \text{lb. } 40\% \text{ cream}$$

In the process of solving the formula becomes:

$$\frac{55.03 - 15.69}{0.40 - 0.04} = \frac{39.34}{0.36} = 109.28 \text{ lb. } 40\% \text{ cream needed.}$$

Therefore this figure (109.28) lb. 40% cream is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. fat, lb. s.s., and lb. t.s. contained in the cream. These are obtained by the following multiplications:

109.28 lb. × 40% fat=43.71 lb. fat
109.28 lb. × 5.35% s.s.=5.85 lb. s.s.
109.28 lb. × 45.35% t.s.=49.56 lb. t.s.

Step 7: The lb. of milk needed are computed by subtraction thus:

392.21 lb. milk and cream (from step 6)
less 109.28 lb. cream (from step 6)

leaves 282.93 lb. milk needed

This figure (282.93) lb. 4% milk is entered in the weight column of the proof sheet. The following multiplications give the lb. fat, lb. s.s., and lb. t.s. which the milk contains, so that these figures may be entered in their respective columns of the proof sheet.

282.93 lb. × 4% fat=11.32 lb. fat
282.93 lb. × 8.79% s.s.=24.87 lb. s.s.
282.93 lb. × 12.79% t.s.=36.19 lb. t.s.

Step 8: Each column of the proof sheet is now totaled and these totals should agree with the corresponding figure of the desired mix. In other words, the total weight of all ingredients should equal the desired weight of the mix, the total fat supplied by all ingredients should equal the fat desired in the mix, and so on. However, if the decimals are not carried far enough, these totals may sometimes be slightly higher or slightly lower than the corresponding figure of the desired mix. This apparent error may be insignificant, as shown by step 9.

The total solids test is computed by division, thus:

$$\frac{333.40 \text{ lb. t.s.}}{900 \text{ lb. mix}} = 0.3593 \text{ or } 35.93\% \text{ t.s.}$$

$\frac{90.37 \text{ lb. s.s.}}{900 \text{ lb. mix}} = 0.1004$ or 10.04% s.s., and similarly calculate % fat, % sufect, % egoso and % stab.

Step 9: The accuracy of the calculations may be determined by comparing the calculated % for each constituent with the corresponding test of the desired mix. For example, in this problem, the calculated % of s.s. is 10.04% (see step 8) which is compared with 10% s.s. of the desired mix. Since the difference between these two percentages is less than 0.1, it is not significant. Similar comparisons for each constituent show no significant differences, and therefore the calculations are correct.

Step 10: Since the actual cost depends upon many factors, cost figures are not calculated in this problem.

The completed proof sheet appears as follows:

Ingredients Used	*Weight lb.*	*Calculated Constituents*						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
frozen cream	40.00	20.00	1.78				21.78	
30% cream	90.00	27.00	5.62				32.62	
suconski	25.00		7.00	10.50			17.50	
3% milk	100.00	3.00	8.33				11.33	
sweetose	30.00			20.10			24.90	
gelatin	3.00					2.70	2.70	
frozen egg yolk	9.00	2.97			4.50		4.50	
cane sugar	95.40			95.40			95.40	
conski	115.39		36.92				36.92	
40% cream	109.28	43.71	5.85				49.56	
4% milk	282.93	11.32	24.87				36.19	
Total lb.	900.00	108.0	90.37	126.0	4.50	2.70	333.40	
Calculated %		12%	10.04%	14%	0.5%	0.3%	35.93%	
Check with desired wt. and %	900 [a]	108 12%	90 10%	126 14%	4.5 0.5%	2.7 0.3%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

TABLE 12. APPROXIMATE COMPOSITION AND WEIGHTS PER GALLON OF INGREDIENTS USED IN ICE CREAM MIX

Ingredient	*Per Cent Fat*	*Per Cent Serum Solids*	*Per cent Sufect*	*Per cent Total Solids*	*Weight per Gallon lb.*
Water	0.00	0.00	0.00	0.00	8.3
Skim milk from 3.0% milk	0.00	8.60	0.00	8.60	8.7
Skim milk from 4.0% milk	0.00	9.00	0.00	9.00	8.7
Milk	3.00	8.33	0.00	11.33	8.6
Milk	4.00	8.79	0.00	12.79	8.6
Milk	5.00	9.10	0.00	14.10	8.6
Cream	12.00	7.80	0.00	19.80	8.5
Cream	15.00	7.57	0.00	22.57	8.5
Cream	18.00	7.31	0.00	25.31	8.5
Cream	20.00	7.13	0.00	27.13	8.5
Cream	25.00	6.68	0.00	31.68	8.4
Cream	30.00	6.24	0.00	36.24	8.4
Cream	35.00	5.69	0.00	40.69	8.4
Cream	40.00	5.35	0.00	45.35	8.3
Cream, frozen	50.00	4.45	0.00	54.45	8.2
Cream, plastic	80.00	1.80	0.00	81.80	....
Butter, unsalted	84.00	1.00	0.00	85.00	....
Butter oil	99.00	0.00	0.00	99.00	....
Evaporated milk, canned	8.00	20.00	0.00	28.00	8.9
Evaporated milk, bulk	10.00	23.00	0.00	33.00	9.2
Sweetened condensed wholemilk	8.00	23.00	42.00	73.00	9.2
Condensed skim unsweetened	0.00	32.00	0.00	32.00	9.4
Condensed skim sweetened	0.00	27.00	42.00	69.00	9.2
Skim milk powder (non-fat dry milk solids)	0.00	97.00	0.00	97.00	....
Whole milk powder	26.00	72.00	0.00	98.00	....

TABLE 13. APPROXIMATE DATA ON EGG PRODUCTS TO SERVE AS A GUIDE IN FIGURING MIXES

Egg Product	*Pounds per dozen eggs*	*Eggs per lb. of egg product*	*Egg Fat %*	*Egoso %*	*Total Solids %*
Fresh eggs (edible portion)	1.17	10.0 to 10.6	10.5	20.0	26.3
Egg yolk	0.50	24	33.3	50.5	50.5
Egg white	0.67	18	0.2	.....	13.8
Dried whole egg	0.33	36	40.0	55.0	94.0
Dried egg yolk	0.25	48	62.5	94.0	94.0
Dried egg white	0.083	144	1.4	.....	96.0

TABLE 14. SOURCE OF SUFECT (SWEETENING EFFECT) IN ICE CREAM
APPROXIMATE DATA TO SERVE AS A GUIDE IN FIGURING MIXES

Commercial Product	*Physical Appearance*	*Type of Sugar*	*Sufect Content Per cent*	*Pounds to equal 1 lb. of Sucrose*	*Percentage of total sufect it can supply* [1]	*Per cent total solids*	*Weight per Gallon*
Sugar Granulated sugar (Cane or beet)	dry crystals	Sucrose	100	1.00	100	100	7.5
Dextrose Cerelose Dextrose hydrate Corn sugar	dry crystals	Glucose	80	1.25	35	92	
Corn syrup solids Frodex	dry crystals	Dextrose & Maltose	47	2.10	35	96.5	
Liquid sugar [2]	liquid	Sucrose	67	1.50	100	67.0	11.1
Invert sugar syrup [3]	liquid	Dextrose & Levulose	95	1.05	33	74.0	11.5
Corn syrup [4] Sweetose [4]	liquid	Dextrose & Maltose	67	1.50	35	83.0	9.5
Honey	liquid	Dextrose Levulose Sucrose	75	1.40	30 [5]	82.0	

[1] The recommended maximum amount. For example: dextrose should supply no more than 35% of all the sufect in the mix.
[2] The usual liquid sugar (67%) employed by ice cream makers.
[3] Assuming 95% complete inversion with a 74% sucrose solution.
[4] The usual commercial syrup of 43° Baumé.
[5] Assuming a mild flavored honey, less if strong flavored.

CHAPTER IX

RESTANDARDIZING AND CALCULATING SOME UNUSUAL MIXES

RESTANDARDIZING A MIX OR CORRECTING MIXES HAVING AN UNDESIRED COMPOSITION

Sometimes when a mix has been made it is found by analysis to have a composition different from that which is desired, and should be designated "incorrect mix." This condition can easily be corrected by restandardizing; *i.e.,* by adding sufficient quantities of one or several ingredients, to give the desired composition. This obviously increases the total amount of the mix and requires a vat large enough to hold the added ingredients, plus the incorrect mix so that they may be properly blended. Usually the total weight of all the added ingredients will not be more than one-third of the weight of the "incorrect mix." For example: the total amount of sugar, cream, stabilizer, *etc.,* necessary to restandardize 900 pounds of incorrect mix will usually be less than 300 pounds.

If the vat space is limited, it may be convenient to store a part (usually half) of the incorrect mix while the other part is used as one ingredient of the next batch of mix, thus distributing the incorrect mix between the two next batches. This method is illustrated by problem 5.

If vat space is available, the entire incorrect mix may be used as one ingredient of a batch having a total weight approximately one-third larger than the weight of the incorrect mix. In this manner the calculations will be similar to problem 5, and a smaller amount of added ingredients will be used.

Problem 5: Restandardizing an Incorrect Mix

Calculate the amount of ingredients required to make 1800 lb. of mix testing 14% fat, 10% s.s., 14% sufect, and 0.3% stabilizer. We want to use 900 lb. (half of a batch not correctly made) of mix testing 10% fat, 11% s.s., 14% sufect, 0.5% stabilizer and 35.5% total solids. In addition to this mix there is available 40% cream, 4% milk, suconski (42% sugar, 30% s.s.), cane sugar and gelatin.

Solution:

This problem is solved in the same manner as problem 4, using the formulas and procedure steps that are used for other complex mixes.

Step 1:

available ingredients	desired mix
incorrect mix, 10% fat, 11% s.s., 14% sufect, 0.5% stab., 35.5% t.s.	fat, 14% of 1800 lb.=252 lb.
gelatin, 90% t.s.	s.s., 10% of 1800 lb.=180 lb.
suconski, 30% s.s., 42% sufect	sufect, 14% of 1800 lb.=252 lb.
cane sugar	stab., 0.3% of 1800 lb.=5.4 lb.
cream, 40% fat, 5.35% s.s.	
milk, 4% fat, 8.79% s.s.	

Step 2: Proof sheet.

Ingredients Used	*Weight lb.*	Calculated constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
Incorrect mix								
gelatin								
suconski								
cane sugar								
Cream								
Milk								
Total lb.								
Calculated %		%	%	%	%	%	%	
Check with desired wt. and %	1800 [a]	252	180	252		5.4		
		14%	10%	14%		0.3%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

Step 3: Since 900 lb. of incorrect mix is all going to be used in this problem, it may be entered in the proof sheet immediately. The amount of each constituent contained in the incorrect mix is obtained by the following multiplications and entered in their respective columns of the proof sheet.

900 lb. × 10% fat=90.0 lb. fat

900 lb. × 11% s.s.=99.0 lb. s.s.

900 lb. × 14% sufect=126.0 lb. sufect

900 lb. × 0.5% stab.=4.5 lb. stab.

900 lb. × 35.5% t.s.=319.5 lb. t.s.

Now subtract each of these amounts from the corresponding figure of the desired mix, which leaves 900 lb. mix, 162 lb. fat, 81 lb. s.s., 126 lb. sufect, 0.9 lb. stab. Now proceed to calculate the amounts of the remaining ingredients needed to make 900 lb. of mix containing 162 lb. fat, 81 lb. s.s., 126 lb. sufect and 0.9 lb. stab.

Gelatin is the only remaining source of stabilizer and it contains 90% t.s. Therefore the 0.9 lb. of needed stab. will require 1.0 lb. gelatin $\left\{\frac{0.9}{0.90}=1.0.\right\}$ This figure (1.0) is entered in the weight column of the proof sheet. Also enter 0.9 lb. in the stab. column, and in the t.s. column of the proof sheet.

Step 4: To find the amount of suconski needed, it will be necessary to use formula No. II. The figures to substitute in the formula are obtained as follows:

lb. s.s. needed=81 (see step 3)

lb. serum of mix=611 lb., obtained by the following calculations:

first find the sum of:

162 lb.	fat	(see step 3)
126 lb.	sufect	(see step 3)
1 lb.	gelatin	(see step 3)
289 lb.	total	

then subtract 289 lb. from 900 lb. (the remaining total weight as shown in step 3), and this leaves 611 lb., the weight of the serum.

lb. s.s. in 1 lb. condensed=0.30, obtained by multiplying 1 lb. suconski by 30% (its s.s. test).

lb. serum in 1 lb. condensed=0.58 lb., obtained as follows:

1 lb. suconski $\times$ 42% sugar=0.42 lb. sugar,

then, 1 lb. suconski—0.42 lb. sugar=0.58 lb. serum

These figures are substituted in formula No. II thus:

$$\frac{81.0 \text{ lb.} - (611 \times 0.09)}{0.30 - (0.58 \times 0.09)} = \text{lb. suconski needed}$$

As the computations are made this formula becomes:

$$\frac{81.0 - 54.99}{0.30 - 0.052} = \frac{26.0}{0.248} = 104.84 \text{ lb. suconski needed.}$$

This figure is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. s.s., lb. sufect, and lb. t.s. which the 104.84 lb. suconski contain. These are obtained by multiplication as follows:

104.84 lb. $\times$ 30% s.s.=31.45 lb. s.s.

104.84 lb. $\times$ 42% sufect=44.03 lb. sufect

104.84 lb. $\times$ 72% t.s.=75.48 lb. t.s.

Step 5: To calculate the amount of sugar needed, first subtract the 44.03 lb. sufect supplied by suconski (see step 4) from the 126 lb. sufect needed (see step 3). This leaves 81.97 lb. sufect to be obtained from cane sugar which is 100% sufect. This means that 81.97 lb. of cane sugar is needed and that figure can be entered in the proof sheet under weight, sufect, and t.s.

Step 6: The amount of cream needed is calculated with the aid of formula No. III. The figures to substitute in the formula are obtained as follows:

lb. fat needed=162 (see step 3)

lb. milk and cream needed=712.19 lb., obtained by calculations as follows:

first find the sum of:

1.0	lb. gelatin
104.84	lb. suconski
81.97	lb. cane sugar
187.91	lb. total

then subtract 187.91 from 900 lb. (the remaining total weight as shown in step 3), this leaves 712.19 lb., the amount of milk and cream needed.

lb. fat in 1 lb. cream=0.40, obtained by multiplying 1 lb. cream × 40% fat.

lb. fat in 1 lb. milk=0.04, obtained by a similar multiplication.

These figures are substituted in formula No. III thus:

$$\frac{162 \text{ lb.} - (712.19 \text{ lb.} \times 4\%)}{0.40 - 0.04} = \text{lb. } 40\% \text{ cream needed}$$

As the computations are made, this formula becomes

$$\frac{162 - 28.49}{0.36} = \frac{133.51}{0.36} = 371.00 \text{ lb. } 40\% \text{ cream needed.}$$

This figure (371 lb.) is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet the lb. fat, lb. s.s., and lb. t.s. which are contained in the cream, thus:

371 lb. × 40% fat=148.40 lb. fat

371 lb. × 5.35% s.s.=19.87 lb. s.s.

371 lb. × 45.35% t.s.=168.25 lb. t.s.

Step 7: The lb. of milk needed are obtained by subtraction, thus:

712.19 lb. milk and cream (see step 6),

less 371.00 lb. cream (see step 6)

leaves 341.19 lb. milk needed

This figure (341.19) is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet the lb. fat, lb. s.s., and lb. t.s. which are contained in the milk. These are obtained by the following mutiplications:

341.19 lb. × 4% fat=13.65 lb. fat

341.19 lb. × 8.79% s.s.=29.99 lb. s.s.

341.19 lb. × 12.79% t.s.=43.64 lb. t.s.

Step 8: Each column of the proof sheet is now totaled, and these totals should agree with the corresponding figure of the desired mix. See explanation Problem 4. Step 8.

The total solids test is computed by division, thus:

$$\frac{689.74 \text{ lb. t.s.}}{1800 \text{ lb. mix}} = 0.3832 = 38.32\% \text{ t.s.}$$

Likewise compute the "calculated %" for each of the constituents, thus:

$$\frac{180.29 \text{ lb. s.s.}}{1800 \text{ lb. mix}} = 0.1001 = 10.01\% \text{ s.s.}$$

Step 9: The accuracy of the calculations may be determined by comparing the calculated % for each constituent with the corresponding test of the desired mix. For example, in this problem, the "calculated %" of s.s. is 10.01% (see step 8) which is compared with the 10% s.s. of the desired mix. Since the difference between these two percentages is less than 0.1 it is not significant. Similar comparisons for each constituent show no significant differences, and therefore the calculations are correct.

Step 10: Calculate the actual cost if desired and enter in proof sheet.

The completed proof sheet appears as follows:

Ingredients Used	*Weight lb.*	Calculated Constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
incorrect mix	900.00	90.00	99.00	126.00		4.50	319.50	
gelatin	1.00					0.90	0.90	
suconski	104.84		31.45	44.03			75.48	
cane sugar	81.97			81.97			81.97	
cream	371.00	148.40	19.85				168.25	
milk	341.19	13.65	29.99				43.64	
Total lb.	1800.00	252.05	180.29	252.00		5.40	689.74	
Calculated %		14.00%	10.01%	14%		0.3%	38.32%	
Check with desired wt.	1800 [a]	252	180	252		5.4		
and %		14%	10%	14%		0.3%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

UNUSUAL COMPLEX MIXES

Sometimes, on rare occasions, an unusual combination of ingredients for an ice cream mix will be selected for reasons of economy. These unusual combinations make the calculations somewhat longer and slightly more complicated. They can be grouped in two general types, illustrated by problems 6 and 7.

A. **When no dry source of sucrose is available and there are three sources of serum solids, one of which is a sweetened condensed product.**

PROBLEM 6:

Calculate the amount of ingredients needed to make 900 lb. mix testing 12% fat, 10% s.s., 14% sufect, and 0.4% stabilizer. The available ingredients are: 40% cream, 4% milk, Dri-Sweet to supply ¼ of the sufect, sweetened condensed whole milk (8% fat, 42% sugar, 23% s.s.), liquid sugar (67% sufect, 67% t.s.) and gelatin.

SOLUTION:

This complex mix has three sources of sufect, three sources of s.s., and three sources of fat. Therefore the calculations will be made using formulas No. II and No. III.

Steps 1 through 3: These steps completed as in Problem 3 will yield a proof sheet as follows:

Ingredients Used	*Weight lb.*	Calculated Constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	4.0					3.6	3.6	
Dri-Sweet	67.02			31.5			64.67	
sw. cond. whole milk liquid sugar cream, 40% milk, 4%								
Total lb.								
Calculated %								
Check with desired wt.	900 [a]	108	90	126		3.6		
and %		12%	10%	14%	%	0.4%		

[a] includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

Step 4: To find the amount of sweetened condensed whole milk needed, use formula No. II. The figures to substitute in the formula are obtained as follows:

lb. s.s. needed=90 (from step 2)

lb. serum of mix=605 lb., obtained by calculation as follows:

first add: 108.00 lb. fat
4.00 lb. gelatin
67.02 lb. Dri-Sweet
94.50 lb. sufect (from liquid sugar and sw. cond. wh. milk)
21.48 lb. estimated water in the liquid sugar used

295.00 lb. total, that are not serum

then: 900 lb. mix — 295 lb.=605 lb. serum of the mix

Notice that in formula No. II, it is necessary to use the lb. of sufect **source** and in this problem part of the sufect **source** is liquid sugar. Therefore part of the 94.50 lb. sufect will come from liquid sugar and the lb. of sufect **source** will be greater than 94.50 lb. It is impossible at this time to tell how much greater it will be, so an estimate is made and the figure 21.48 lb. is used. Any other estimate will be equally satisfactory.

lb. s.s. in 1.0 lb. condensed:

1.0 lb. sweetened condensed whole milk contains 23% s.s. or .23 lb. s.s.

lb. serum in 1.0 lb. condensed:

1.0 lb. sw. cond. whole milk contains 42% sugar or .42 lb. sugar

1.0 lb. sw. cond. whole milk also contains 8% fat or .08 lb. fat

then 1.0 lb. sw. cond. whole milk $-$ (.42 lb. sugar $+$ .08 lb. fat) $=$ 1.0 $-$ .50 $=$ .50 lb. serum in 1.0 lb. sw. condensed whole milk.

Now substitute these figures in formula No. II and complete the calculations, thus:

$$\frac{90-(605\times 0.09)}{0.23-(0.50\times 0.09)}=\frac{90-54.45}{0.23-0.045}=\frac{35.55}{0.185}=192.16 \text{ lb. sw. cond. wh. milk}$$

Since the calculation involved an estimate, this figure 192.16 lb. is probably incorrect and therefore it must be tested for accuracy before proceeding with other calculations.

Step 4a: The correctness of the lb. of sweetened condensed whole milk is tested as follows:

192.16 lb. sw. cond. wh. milk $\times$ 42% sugar $=$ 80.707 lb. sufect it will supply

94.50 lb. sufect (from liq. sugar and sw. cond. wh. milk) $-$ 80.707 $=$ 13.793 lb. sufect to obtain from liquid sugar

It follows that $\frac{13.793 \text{ lb.}}{0.67}=20.59$ lb. liquid sugar needed.

Now add	20.59	lb. liquid sugar
	80.707	lb. sufect supplied by the 192.16 lb. sw. cond. wh. milk
	101.297	lb.
Also add	94.50	lb. sufect (supplied by sw.cond.wh.milk and liquid sugar)
	21.48	lb. estimated water (part of liquid sugar used)
	115.98	lb.

Compare the 101.297 lb. with the 115.98 lb. Since the difference between these figures is more than 1 lb., it proves that the figure 192.16 lb. sw. cond. whole milk is wrong because the estimated 21.48 lb. was wrong.

Therefore steps 4 and 4a must be repeated using a revised estimate in

place of the figure 21.48 lb. The revised estimate must be such as to make the total, (94.50 plus the new estimate), **somewhere between** 101.297 lb. and 115.98 lb. This time assume the estimated water to be 8.0 lb. which will give a total, (94.50+8.0) of 102.50 lb.

Now repeat step 4, using this revised estimate.

lb. serum of mix=618.48 lb., obtained by calculation as follows:

first add: 108.00 lb. fat
4.00 lb. gelatin
67.02 lb. Dri-Sweet
94.50 lb. sufect (from liquid sugar and sw. cond. whole milk)
8.00 lb. estimated water in liquid sugar used

281.52 lb. total, that are not serum

then: 900 lb. mix — 281.52 lb.=618.48 lb. serum of mix

Then substituting in the formula:

$$\frac{90-(618.48\times 0.09)}{0.23-(0.50\times 0.09)}=\frac{34.337}{0.185}=185.60 \text{ lb. sw. cond. whole milk needed.}$$

Repeating step 4a to test the correctness of this new answer:

185.60 lb. × 0.42=77.952 lb. sufect from 185.60 lb. sw. cond. whole milk

$$\frac{94.50-77.952}{0.67}=\frac{16.548}{0.67}=24.70 \text{ lb. liquid sugar needed.}$$

Adding 77.592 lb. and 24.70 lb.=102.292 lb.

Compare with 94.50 + 8 lb.=102.50 lb.

The comparison shows that the difference is less than 1.0 lb., and therefore the figure 185.60 lb. sw. cond. whole milk is correct.

Sometimes it is necessary to make a second or third revision of the estimate, each time repeating steps 4 and 4a.

When the correct figure for sw. cond. whole milk has been found, the proof sheet can be filled in with values found by multiplication:

185.60 lb. × 42% = 77.952 lb. sufect
185.60 lb. × 8% = 14.848 lb. fat
185.60 lb. × 23% = 42.688 lb. s.s.
185.60 lb. × 73% = 135.488 lb. t.s.

Step 5: The amount of liquid sugar needed as determined in step 4a is 24.70 lb.

These 24.70 lb. contain 67% sufect or 24.70 × .67=16.55 lb. sufect. This figure (16.55) can be entered in the sufect and the t.s. column of the proof sheet.

Step 6: To find the amount of cream needed, use formula No. III.

lb. fat needed=93.152 lb., obtained as follows:

108.00 lb. total fat desired
— 14.848 lb. supplied from the 185.60 lb. sw. cond. whole milk

leaves 93.152 lb. needed from milk and cream

lb. milk and cream needed=618.68 lb., obtained as follows:

first add: 4.00 lb. gelatin
67.02 lb. Dri-Sweet
185.60 lb. sw. cond. whole milk
24.70 lb. liquid sugar

281.32 lb. total

then: 900 lb. mix — 281.32 lb.=618.68 lb. milk and cream needed.

Substituting in formula No. III:

$$\frac{93.152 - (618.68 \times 0.04)}{.40 - 0.04} = \frac{68.405}{.36} = 190.00 \text{ lb. } 40\% \text{ cream.}$$

This 90 lb. cream supplies 76.00 lb. fat, 10.165 lb. s.s., and 86.165 lb. t.s. which can be entered in their respective columns in the proof sheet.

Steps 7 through 10 are similiar to the same steps in problem 3. When completed they yield a proof sheet as follows:

Ingredients Used	*weight lb.*	Calculated Constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	4.00					3.6	3.60	
Dri-Sweet	67.02			31.50			64.67	
sw. cond. whole milk	185.60	14.85	42.69	77.95			135.49	
liquid sugar	24.70			16.55			16.55	
cream, 40%	190.00	76.00	10.17				86.17	
milk, 4%	428.68	17.15	37.68				54.83	
Total lb.	900.00	108.00	90.54	126.00		3.6	361.31	
Calculated %		12.0%	10.06%	14.0%	%	0.4%	40.15%	
Check with desired wt.	900	108	90	126		3.6		
and %		12%	10%	14%		0.4%		

B. The second type of unusual combination of ingredients occurs **when sweet cream and a condensed whole milk product are used as the only sources of milk solids.** This includes the use of sweet cream with such products as evaporated milk, sweetened condensed whole milk, whole milk powder, and sweet cream buttermilk powder.

PROBLEM 7:

A 700 lb. mix testing 14% fat, 9% s.s., 15% sufect, and 0.3% stabilizer is desired. The following materials are "left-overs" to be used up to avoid loss: 50 lb. cream (30% fat, 6.24% s.s.), and 100 lb. milk (3% fat, 8.33% s.s.). The following ingredients are also available: gelatin, cane sugar, 40% cream, and sweetened condensed whole milk (testing 8% fat, 23% s.s., 42% sugar), and water.

SOLUTION:

Steps 1 through 3 completed as in problem 4 will produce the partially completed proof sheet that follows:

Ingredients Used	*Weight lb.*	Calculated Constituents						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
cream, 30%	50.00	15.00	3.12				18.12	
milk, 3%	100.00	3.00	8.33				11.33	
gelatin	2.33					2.10	2.10	
cane sugar								
sw. cond. whole milk								
cream, 40%								
water								
Total lb.								
Calculated %								
Check with desired wt.	700	98	63	105		2.1		
and %		14%	9%	15%		0.3%		

It now appears that 547.67 lb. total weight containing 80 lb. fat, 51.55 lb. s.s., and 105 lb. sufect remains to be prepared by mixing cream, sugar, sweetened condensed whole milk, and water.

Step 4: The combined weight of cream and condensed product is calculated as follows:

51.55 lb. s.s. desired × (40.0—8.0) difference in the fat tests of the two products = 1649.60

80 lb. fat desired × (23.0—5.35) difference in the s.s. tests of the two products = 1412.00

Then: 1649.60 + 1412.00 = 3061.60

40.0 (fat test of the cream) × 23.0 (s.s. test of sw. cond. whole milk) = 920.00

8.0 (fat test of sw. cond. whole milk) × 5.35 (s.s. test of the cream) = 42.80

Then: 920.00 — 42.80 = 877.20

Finally: $\frac{3061.60}{877.20} \times 100 = 349.02$ lb. cream and sw. cond. whole milk.

Step 5: To find the amount of cream needed: Substitute in formula No. III.

$$\frac{80 - (349.02 \times 0.08)}{.40 - 0.08} = \frac{52.078}{.32} = 162.75 \text{ lb. } 40\% \text{ cream needed.}$$

Enter in their respective columns of the proof sheet, the weight, lb. fat, lb. s.s., and lb. t.s. supplied by the cream.

Step 6: The amount of sweetened condensed whole milk needed is calculated as follows:

349.02 lb. (wt. of cream and condensed)—162.75 lb. cream=
186.27 lb. sw. cond. whole milk needed.

Enter in their respective columns of the proof sheet, the weight, lb. fat, lb. s.s., lb. sufect, and lb. t.s. supplied by the sw. cond. whole milk.

Step 7: The amount of sugar needed is calculated as follows:

105 lb. sufect desired — 78.23 lb. sufect supplied by sw. cond. whole milk=26.77 lb. sufect to be supplied by the sugar.

Therefore: $\frac{26.77}{100\%} = 26.77$ lb. sugar needed

Enter this in the respective columns of the proof sheet.

Step 8: To find the amount of water needed:

700 lb. — total wt. of all other ingredients = 171.88 lb. water needed.

Completed proof sheet appears as follows;

Ingredients Used	*Weight lb.*	*Calculated Constituents*						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
cream, 30%	50.00	15.00	3.12				18.12	
milk, 3%	100.00	3.00	8.33				11.33	
gelatin	2.33					2.10	2.10	
cane sugar	26.77			26.77			26.77	
sw. cond. whole milk	186.27	14.90	42.84	78.23			135.97	
cream, 40%	162.75	65.10	8.71				73.81	
water	171.88							
Total lb.	700.00	98.00	63.00	105.00		2.10	268.10	
Calculated %		14.0%	9.00%	15.0%		0.3%	38.30%	
Check with desired wt.	700	98	63	105		2.1		
and %		14%	9%	15%		0.3%		

If preferred, this type of problem (Problem 7) may be calculated by the use of formulas No. IV and No. V to find the pounds of condensed product and the pounds of cream needed.

FORMULA No. IV (See Problem 7)

$$\frac{(\text{cream \% fat})(\text{lb. s.s. desired})-(\text{cream \% s.s.})(\text{lb. fat desired})}{(\text{cream \% fat})(\text{cond. \% s.s.})-(\text{cond. \% fat})(\text{cream \% s.s.})} \times 100 = \text{lb. cond. needed.}$$

Substitute the figures given in the problem, thus:

$$\frac{(40\times 51.55)-(5.35\times 80)}{(40\times 23)-(8\times 5.35)} \times 100 = \frac{(2062-428)}{(920-42.80)} \times 100 = \frac{1634}{877.20} \times 100 = 186.27 \text{ lb. cond. needed}$$

FORMULA No. V (See Problem 7)

$$\frac{(\text{cond. \% s.s.})(\text{lb. fat desired})-(\text{cond. \% fat})(\text{lb. s.s. desired})}{(\text{cond. \% s.s.})(\text{cream \% fat})-(\text{cond. \% fat})(\text{cream \% s.s.})} \times 100 = \text{lb. cream needed}$$

Substitute the figures given in the problem, thus:

$$\frac{(23\times 80)-(8\times 51.55)}{(23\times 40)-(8\times 5.35)} \times 100 = \frac{(1840-412.40)}{(920-42.80)} \times 100 = \frac{1427.60}{877.20} \times 100 = 162.75 \text{ lb. cream needed}$$

CALCULATING A MIX TO BE MADE IN THE VACUUM PAN

Some dairy plants manufacture condensed whole milk which they later use in making ice cream mix. Nearly half of the time and labor required for these two operations can be eliminated by mixing the ingredients before condensing in the vacuum pan. This process of making the mix in a vacuum pan may be desirable whenever there is available the necessary equipment, a sufficient supply of milk, and a large outlet for the mix.

These vacuum pan mixes are readily calculated by using formulas Nos. VI and VII as in the following steps:

1. List the available ingredients and the number of pounds of each constituent of the desired mix.

2. Make a proof sheet as on page 61, and enter in it the information obtained in step 1.

3. Compute the needed amount of each non-milk product, such as egg, stabilizer, *etc.,* and enter it in the proof sheet.

4. Calculate the needed total pounds of milk and cream by using formula No. VI.

5. Calculate the pounds of cream needed by using formula No. VII, and enter it in the proof sheet.

6. Subtract the pounds of cream needed from the total pounds of milk and cream to obtain the pounds of milk needed. This is entered in the proof sheet.

7. Total each column in the proof sheet and check for accuracy. The total weight of all ingredients will be greater than the desired weight of the mix, and this excess is the amount of water to remove in the condensing process. The total of each of the other columns in the proof sheet should agree with the corresponding figure of the desired mix.

FORMULA No. VI

$$\frac{\text{lb. of mix} \times [\text{s.s. test of mix} + (0.09^{a} \times \text{fat test of mix})]}{9.0^{a}} = \text{total lb. milk and cream needed.}$$

[a] This is assuming that skim milk tests 9% s.s. However skim milk obtained from 3% (fat) milk contains only 8.6% s.s., therefore, in this problem, substitute 0.086 and 8.6 respectively for 0.09 and 9.0

FORMULA No. VII

$$\frac{\text{lb. fat needed} - (\text{lb. milk and cream needed}^{a} \times \% \text{ fat in milk})}{\text{lb. fat in 1.0 lb. cream—lb. fat in 1.0 lb. milk}} = \text{lb. cream needed}$$

[a] Obtained by formula No. VI.

PROBLEM 8:

A vacuum pan will be used in making a 5,400 lb. mix testing 12% fat, 11% s.s., 14% sufect, 0.5% egoso, and 0.3% stab. The available ingredients

are: gelatin, fresh eggs, sweetose (43° Baumé) to furnish one-fourth of the total sufect, liquid sugar (67° Brix), cream (35% fat), and milk (3% fat). How much of each ingredient is needed?

SOLUTION:

This mix is smaller and contains a larger variety of ingredients than most mixes which are made in a vacuum pan. Therefore it will not only illustrate the procedure of calculating simple vacuum pan mixes, but will also serve as a guide in calculating the most complex ones.

Step 1:

available ingredients	**desired mix**
gelatin, 90% t.s.	fat, 12% of 5,400 lb.=648 lb.
fresh eggs, 10.5% fat, 21.6% egoso, 26.3% t.s.	s.s., 11% of 5,400 lb.=594 lb.
sweetose, 67% sufect, 83% t.s.	sufect, 14% of 5,400 lb.=756 lb.
liq. sugar, 67% sufect, 67% t.s.	egoso, 0.5% of 5,400 lb.=27 lb.
cream 35% fat, 5.69% s.s.	stab., 0.3% of 5,400 lb.=16.20 lb.
milk, 3% fat, 8.33% s.s.	

Step 2: Proof Sheet

Ingredients Used	*Weight lb.*	*Calculated Constituents*						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin								
fresh eggs								
sweetose								
liq. sugar								
cream								
milk								
Total lb.								
Calculated %		%	%	%	%	%	%	
Check with desired wt.	5400*	648	594	756	27	16.2		
and %		12%	11%	14%	0.5%	0.3%		

* includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

Step 3: To compute the amount of non-milk products:

Gelatin, here, is the only source of stabilizer, and it contains 90% t.s. Therefore the 16.2 lb. of needed stabilizer will require 18.00 lb. of gelatin, $\frac{16.2 \text{ lb.}}{0.90} = 18.00$ This figure (18) is entered in the weight column of the proof sheet, also enter 16.2 lb. in stab. column and in t.s. column of the proof sheet.

The fresh eggs are the only source of egoso, and they contain 21.6%

egoso. Therefore 21.6% of the number of lb. needed must equal 27 lb., the desired amount of egoso. It follows that

$$\frac{27 \text{ lb.}}{0.216} = 125 \text{ lb. fresh eggs needed.}$$

Since the edible portion of a dozen eggs weighs 1.17 lb. (see table 13) it follows that

$$\frac{125 \text{ lb.}}{1.17 \text{ lb.}} = \text{approximately 107 dozen eggs.}$$

Enter the figure (125) in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. fat, lb. egoso, and lb. t.s. contained in the eggs. These figures are obtained by the following multiplication:

125 lb. $\times$ 10.5% fat=13.13 lb. fat
125 lb. $\times$ 21.6% egoso=27.00 lb. egoso
125 lb. $\times$ 26.3% t.s.=32.88 lb. t.s.

The amount of sweetose needed can now be calculated. Since one-fourth of the total desired sufect equals $\frac{756 \text{ lb.}}{4}$, or 189 lb., and since sweetose contains 67% sufect, it follows that $\frac{189 \text{ lb.}}{0.67} = 282.1$ lb. sweetose needed. This number (282.1) is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet the lb. sufect, and the lb. t.s. contained in the sweetose, and obtained by the following multiplications:

282.1 $\times$ 67% sufect=189 lb. sufect
282.1 lb. $\times$ 83% t.s.=234.14 lb. t.s.

To find the remaining amount of sufect needed, subtract the 189 lb. sufect which is supplied by the sweetose from the 750 lb. sufect, desired in the mix. This leaves 567 lb. sufect to be obtained from liquid sugar. The liquid sugar contains 67% sufect and therefore

$$\frac{567 \text{ lb.}}{0.67} = 846.27, \text{ lb., liquid sugar needed.}$$

This number (846.27) is entered in the weight column of the proof sheet. Also enter 567 lb. sufect in the sufect column and in the t.s. column of the proof sheet.

Step 4: To calculate the amount of milk and cream needed, use formula No. VI substituting the figures obtained as follows:

lb. of mix=5,400 (from Step 1)
s.s. test of mix=11.0 (from Step 1. Note that the decimal point is **not** moved to the left.)
fat test of mix=12.0 (from Step 1. Note that the decimal point is **not** moved to the left.)

In this problem, the milk tests 3.0% fat, and skim milk obtained from it will contain 8.6% s.s. Therefore, use 0.086 and 8.6 in place of 0.09 and 9.0 respectively, substituting these figures in the formula gives:

$$\frac{5400 \times [11.0 + (0.086 \times 12.0)]}{8.6} = \text{lb. milk and cream needed.}$$

As the computations are made the formula becomes:

$$\frac{5400 \times (11.0 + 1.03)}{8.6} \text{ or } \frac{5400 \times (12.03)}{8.6} = 7553.72.$$

Therefore, 7553.72 equals the number of pounds of milk and cream needed.

Step 5: To find the lb. of cream needed, use formula No. VII, substituting the figures obtained as follows:

lb. fat needed is obtained by subtracting, thus:

648 lb. fat in mix (see Step 1)

less 13.13 lb. fat obtained from fresh eggs (see Step 3)

leaves 634.87 lb. fat to come from the milk and cream.

lb. milk and cream=7553.72 (see Step 4)

lb. fat. in 1.0 lb. 35% cream=0.35 lb. fat.

lb. fat in 1.0 lb. 3% milk=0.03 lb. fat

Substituting these figures in the formula gives:

$$\frac{634.87 \text{ lb.} - (7553.72 \text{ lb.} \times 3\%)}{0.35 - 0.03} = \text{lb. 35\% cream needed}$$

As the computations are made the formula becomes:

$$\frac{634.87 - 226.61}{0.35 - 0.03} = \frac{408.26}{0.32} = 1275.81 \text{ lb. 35\% cream needed.}$$

Therefore 1275.81 lb. is entered in the weight column of the proof sheet. Also enter in their respective columns of the proof sheet, the lb. fat, lb. s.s., and lb. t.s., contained in the cream. These figures are obtained by the following multiplications:

1275.81 × 35% fat=446.53 lb. fat

1275.81 × 5.69% s.s.=72.59 lb. s.s.

1275.81 × 40.69% t.s.=519.12 lb. t.s.

Step 6: To find the lb. of 3% milk needed:

Since in step 4, it was found that 7553.72 lb. of milk and cream are needed, and in step 5 it was found that 1275.81 lb. of cream are needed; therefore, subtracting the 1275.81 lb., from the 7553.72 lb. leaves 6277.91 lb., 3% milk needed.

This 6277.91 is entered in the weight column of the proof sheet. Also

enter in their respective columns of the proof sheet, the lb. fat, lb. s.s., and lb. t.s. contained in the milk. These figures are obtained by multiplication, thus:

6277.91 lb. $\times$3% fat=188.34 lb. fat
6277.91 lb. $\times$ 8.33% s.s.=522.95 lb. s.s.
6277.91 lb. $\times$ 11.33% t.s.=711.29 lb. t.s.

Step 7: Each column of the proof sheet is totaled and checked for accuracy. It is apparent that the lb. of fat contained in all of the ingredients is equal to the lb. of fat desired in the mix. The same is true for the sufect, egoso, and stabilizer. The total s.s. (595.54 lb.) is larger than the desired 594 lb. of s.s. Therefore compute the s.s. test of the calculated mix thus:

$$\frac{595.54 \text{ lb. total s.s.}}{5400 \text{ wt. desired mix}} = 11.03\%$$

This calculated s.s. test, (11.03%), is slightly higher than the desired 11.00%, but the difference is less than 0.1. It follows that the error is not significant and that the mix is accurately calculated.

The total solids test of the mix is computed by dividing 2080.63 lb. t.s. by the 5400 lb. the weight of the finished mix. Thus $\frac{2080.63}{5400}$=38.53% t.s.

The amount of water to be removed in the vacuum pan is obtained by subtraction, thus:

8825.09 lb., the total weight of all ingredients
less 5400.00 lb., the weight of the finished mix

leaves 3425.09 lb., the weight of water to remove.

The completed proof sheet appears, thus:

Ingredients Used	*Weight lb.*	*Calculated Constituents*						*Cost*
		fat lb.	*s.s. lb.*	*sufect lb.*	*egoso lb.*	*stab. lb.*	*t.s. lb.*	
gelatin	18.00					16.20	16.20	
fresh eggs	125.00	13.13			27.00		32.88	
sweetose	282.10			189.00			234.14	
liquid sugar	846.27			567.00			567.00	
cream	1275.81	446.53	72.59				519.12	
milk	6277.91	188.34	522.95				711.29	
Total lb.	8825.09	648.00	595.54	756.00	27.00	16.20	2080.63	
Calculated %		%	11.03%	%	%	%	38.53%	
Check with desired wt.	5400 *	648	594	756	27	16.2		
and %		12%	11%	14%	0.5%	0.3%		

* includes the lb. t.s. and water which sometimes can be accurately stated only after calculating the mix.

CHAPTER X

CALCULATING COST OF MIXES; AMOUNT OF NEUTRALIZER, PER CENT OVERRUN

CALCULATING THE COST OF THE MIX

The cost of the ingredients in a mix is best determined after the mix has been calculated. A simple procedure is to first find the cost of one pound of each of the ingredients, then multiply the price per pound by the amount of that ingredient used, (*i.e.,* the amount entered in the weight column of the proof sheet); and enter the result in the cost column of the proof sheet. When the cost of each ingredient has been entered in the proof sheet, the column is added to obtain the total cost of all ingredients in the entire batch of mix. When comparing costs one should, of course, be careful to compare the costs of equal amounts of mix.

The cost per pound of mix is a good basis for comparing costs of different mixes and is obtained by dividing total cost by total pounds of mix.

Problem 9 demonstrates how to calculate the cost of ingredients used in problems 1 and 2. Cost in problems 3, 4, and 5 can be calculated in the same manner. The prices of the ingredients are fictitious and any resemblance to actual market value is purely coincidental.

PROBLEM 9 AND SOLUTION:

The purchase price of the ingredients used in problems 1 and 2 is assumed to be:

Ingredient	Cost per lb.
gelatin	$ .90
dried egg yolk	1.00
cane sugar	.08
skipo	.15

cream (30% fat) is $25.00 per 40 qt. can which weighs 84 lb. (Table 12) $= \frac{25.00}{84} = 0.298$

cream (40% fat) is $33.00 per 40 qt. can which weighs 83 lb. (Table 12) $= \frac{33.00}{83} = 0.3976$

conski (27% t. s.) is $5.00 per 40 qt. can which weighs 94 lb. (Table 12) $= \frac{5.00}{94} = 0.0532$

milk (4% fat) is \$5.25 per 100 lb. $= \frac{5.25}{100} = 0.0525$

water $= 0.001$

Now that the price per lb. of all ingredients has been calculated the total cost of the ingredients used in Problem 1, (see proof sheet), can be calculated by multiplication as follows:

Ingredient	Amount		Cost per lb.		Total Cost
gelatin	2.50 lb.	×	0.90	=	\$ 2.25
dried egg yolk	2.39 lb.	×	1.00	=	2.39
cane sugar	63 lb.	×	0.08	=	5.04
cream (30% fat)	145.03 lb.	×	0.298	=	43.22
skipo	41.70 lb.	×	0.15	=	6.26
water	195.38 lb.	×	0.001	=	.20
Total weight	450.00 lb.		Total cost of mix		\$59.36

Cost per lb. of mix in problem 1 $= \frac{59.36}{450} =$ \$0.1319. If desired, enter the cost of each ingredient in cost column of problem 1 proof sheet.

To repeat the procedure, using the ingredients in Problem 2:

Ingredient	Amount		Cost per lb.		Total Cost
gelatin	1.11 lb.	×	0.90	=	\$ 1.00
cane sugar	26 lb.	×	0.08	=	2.08
conski (27% t.s.)	27.5 lb.	×	0.0532	=	1.46
cream (40% fat)	61.61 lb.	×	0.3976	=	24.50
milk (4% fat)	83.78 lb.	×	0.0525	=	4.40
Total weight	200.00 lb.		Total cost of mix		\$33.44

Cost per lb. of mix in problem 2 $= \frac{33.44}{200} =$ \$0.1672. If desired, enter the cost of each ingredient in cost column of problem 2 proof sheet.

This shows that mix in problem 2 costs .0325 cents more per lb. than the mix in problem 1. Cost per pound is a convenient basis for comparing costs of different mixes.

COMPARE FOR COSTS AND QUALITY

The comparison of the cost of either ingredients or mixes should receive careful consideration because many factors are closely related to cost. The use of less expensive ingredients is often good business in that it lowers the cost of the mix. However, substitutions must be made wisely or sometimes they may result in increasing the tendency of certain defects to appear. For example, the mix in problem 1 is less expensive than the mix in problem 2, but it would probably have a more pronounced "condensed" or "serum

solids" flavor. Sometimes these defects can be avoided by properly balancing the mix. However, care must be taken so as not to throw the mix out of balance when the ingredients are changed. For example, in the more expensive mix of problem 2 the conski and milk can not be replaced by skipo and water unless egg yolk solids are added as in problem 1.

Since any change of ingredients will frequently throw a mix out of balance, it seems better to balance a mix properly for each group of ingredients before it is calculated and costs are considered. However, it is well for each factory operator to check carefully on the cost of the ingredients of his standard mixes and so far as possible purchase the ingredients from the most economical source, provided that this will not interfere with the quality, palatability and other desired characteristics of the finished ice cream.

From a practical point of view it should be kept in mind that butterfat is nearly always one of the principal items as well as the most expensive one that enters into the ice cream. So in a general way it may be said that the cheapest source of good quality butterfat should be selected.

Other factors that are closely related to cost include the cost of processing, yield, convenience, *etc*. These factors are not considered here since this chapter deals mainly with the procedure of calculation.

A COMPARISON OF CALCULATING METHODS

Other methods of calculating mixes are available, most of them being either too tedious, too technical and complicated, or unsatisfactory for calculating the more complex mixes. The Pearson square method is successful when the calculation is limited to the proportion of milk and cream needed, but will not readily calculate the needed amount of concentrated serum solids. The algebraic method is equally accurate and applicable to the most complex problems, but it involves rather lengthy calculations and a thorough knowledge of setting up and solving simultaneous equations. It is definitely cumbersome and slow. The so-called "serum point method" and various "arithmetic" methods are basically identical with the formulas presented in these chapters. However, the use of the formulas simplifies the procedure and thus makes it easier to learn.

The use of recipe tables or tabulations which indicate the amount of each ingredient has the advantage of eliminating errors in calculation and saving valuable time. However, a new table must be prepared for every slight change in the desired composition of the mix, and for changes in the source of the constituents. For example, if the mix is prepared using sugar and sweetened condensed skim milk, the table must allow for all variations in the test of the sweetened condensed both in regard to sufect test and serum solids test. Such a table would be practically useless when liquid sugar is substituted for sugar in making the same mix. This indicates the

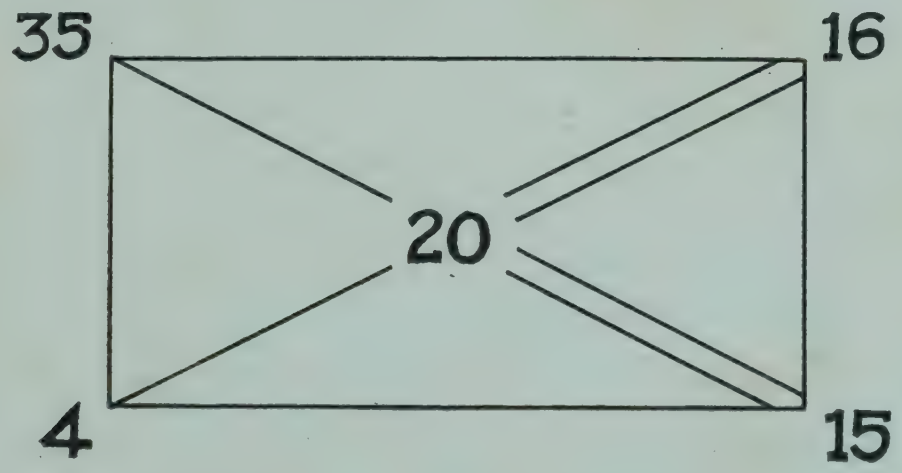
large number of tables necessary to provide for all possible variations in composition and ingredients. Such a compilation in one volume would be too cumbersome for convenient reference. A final advantage of the formulas given in these chapters is that they make possible the calculation of all the tables required by the particular conditions of any manufacturer whenever the tables justify the effort of preparation.

STANDARDIZING MILK AND CREAM

Sometimes it is desirable to use a simple and easy method for standardizing milk and cream so that stocks on hand are always of same tests, a convenience in calculating mixes.

There are several methods of standardizing which are very satisfactory. To find the proportions of milk and cream to use either of the following methods may be employed.

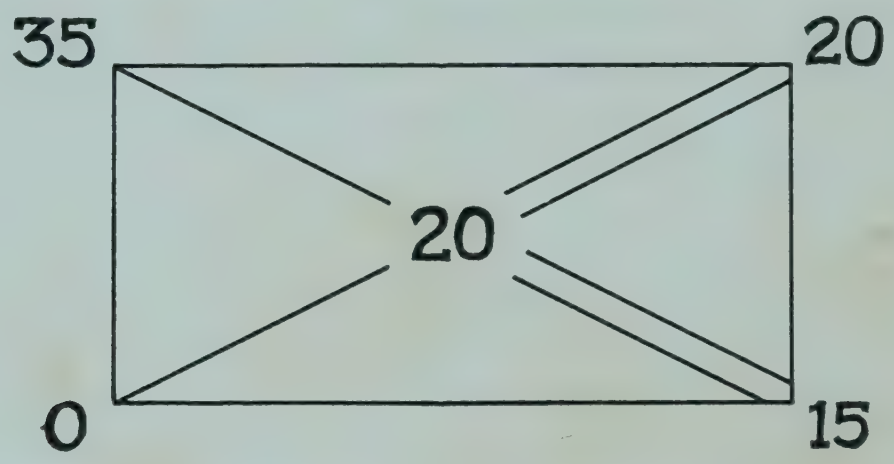
1. Draw a rectangle with two diagonals. At the upper left hand corner place the test of the cream to be standardized. At the lower left hand corner place the test of the milk to be used in standardizing. In the center of the rectangle place the desired test. At the right hand corners place the differences between the numbers at the left hand corner and the number in the center. The number at the upper right-hand corner represents the number of pounds of cream of the richness indicated by the number at the upper left hand corner. The number at the lower right hand corner indicates the number of pounds of milk of the richness indicated by the number at the lower left hand corner. By mixing milk and cream in these proportions the desired test will be obtained. For example, if 35 per cent cream is to be standardized to 20 per cent using 4 per cent milk proceed as follows:



Sixteen, which is the difference between 4 and 20, represents the pounds of 35 per cent cream that must be mixed with 15 pounds of 4 per cent milk to make 31 pounds of 20 per cent cream. When the proportions of milk and cream have been found any amount of 35 per cent cream may be standardized to 20 per cent by mixing with 4 per cent milk in the proportions of

16/31 of cream to 15/31 of milk. For example: if 310 lb. of 20% cream is wanted, then $\frac{16}{31} \times 310 = 160$ lb., the amount of 35% cream needed, and $\frac{15}{31} \times 310 = 150$ lb., the amount of 4% milk needed.

If skim milk is used instead of whole milk the figures would be:



In this case a mixture composed of 20/35 cream and 15/35 skim milk will test 20 per cent.

2. Another method of standardizing that is quite simple and accurate and involves but little figuring is as follows: Multiply the amount of cream by the difference between its test and the required test, and divide the product by the difference between the required test and the test of the milk to be added. Example: Standardize 120 pounds of 30 per cent cream to 20 per cent, using 4.2 per cent milk. $30 - 20 = 10$, which is the difference between the test of the cream and the required test. $20 - 4.2 = 15.8$, which is the difference between the required test and the test of the milk to be added. Using these figures we have $120 \times 10 \div 15.8$ or $\frac{120 \times 10}{15.8} = 75.95$. Therefore, 75.95 pounds of 4.2 per cent milk are required to reduce the test of 120 pounds of 30 per cent cream to 20 per cent. The accuracy of this method is shown by the following figures:

	75.95 lb. 4.2% milk contain		3.1899 lb. fat
	120. lb. 30% cream contain		36. lb. fat
Total	195.95 lb.	Total	39.1899 lb.

Therefore 195.95 lb. 20% cream contain 39.19 lb. fat.

Either of these methods will be found valuable as aids in regulating the quality of the ice cream produced.

NEUTRALIZER CALCULATIONS

The use of neutralizers is discussed in chapter XI, and the directions for making the acidity test of the ice cream mix are given in chapter XXI.

Calculations for determining the amount of dry neutralizer to be used can be made in the following steps:

1. Find the percentage acidity of the mix by use of the N/10 acidity test, p. 227.
2. Find the percentage "normal" acidity of the mix by multiplying the percentage serum solids in the mix by the factor 0.018.
3. Find the percentage acidity to be neutralized by subtracting the percentage normal, desired acidity (result of step 2) from the percentage acidity of the mix (result of step 1). Obviously, if the percentage acidity of the mix is not greater than the normal desired acidity, no neutralizer is needed.
4. Find the total pounds of acidity to be neutralized by muliplying the total weight of the mix by the percentage acidity calculated in step 3.
5. Find the pounds of dry neutralizer to use by multiplying the pounds of acidity (result of step 4) by the factor (in table 15) which corresponds to the neutralizer selected.

Problem 10:

An 1800-pound mix containing 11% serum solids and testing 0.26% acidity is to be neutralized with sodium bicarbonate. How much of this neutralizer is needed?

Solution:

By substituting in the above 5 steps:

1. 0.26% = acidity of the mix.
2. 11.00% s.s. or (.11 × 100) × 0.018 = 0.198% normal desired acidity.
3. 0.26% acidity in mix − 0.198% normal acidity = 0.062% acidity to neutralize.
4. 1800 lb. mix × 0.062% = 1.116 lb. acidity to be neutralized.
5. 1.116 lb. × 1.03 (factor) = 1.15 lb. sodium bicarbonate needed.

The dry neutralizer should be dissolved in about 5 times its weight of water, and when thoroughly dissolved it should be strained into the mix—with agitator running—when the mix temperature has reached 90° to 100° F. After a 5 to 10-minute period the mix is ready to be pasteurized.

Table 15. Factors For Calculating the Amount of Dry Neutralizer

Neutralizer Used	*Factor*
Magnesium oxide	0.30
Magnesium hydroxide	0.39
Calcium hydroxide (slaked lime)	0.44
Sodium bicarbonate (baking soda)	1.03

To Calculate the Amount of Neutralizer Stock Solution. If a liquid neutralizer is preferred a stock solution can be prepared as directed in table 16.

The amount to use is calculated as follows:

1. percentage acidity of mix obtained by acidity test.
2. percentage s.s. of the mix $\times$ 0.018 = percentage normal acidity.
3. percentage acidity in mix — percentage normal acidity = percentage acidity to neutralize.
4. total lb. of mix $\times$ percentage acidity to neutralize $\times$ 0.01644 = pints of neutralizer stock solution.

   This neutralizer stock solution is much too concentrated to use and must be diluted with an equal volume of water before being added to the ice cream mix. (see chapter XI.)

CALCULATING THE PER CENT OVERRUN

There are two basic or fundamental methods of calculating percentage overrun; one is by volume, and the other by weight. Each of these has three modifications. The first is the simplest and perhaps the most widely used, while the second modification is more correct and especially useful in evaluating "plant overrun" for cost studies. The third modification is used for determining the overrun obtained on the plain mix used in making composite ice creams. It recognizes the fact that very little overrun is obtained on the coloring and flavoring material. For example, it is usually desirable to take a lower overrun on composite ice creams than is taken on plain ice creams.

MODIFICATIONS WHEN CALCULATING % OVERRUN BY VOLUME:

1. Useful for plain ice cream.

$$\frac{\text{vol. of ice cream} - \text{vol. of mix}}{\text{volume of mix}} \times 100 = \%\ \text{overrun}$$

   For example: when 5 gal. of mix are frozen to make 9.5 gal. ice cream,

$$\text{then} \frac{9.5 - 5}{5} \times 100 = 90\%\ \text{overrun}$$

2. More correct and useful in evaluating "plant overrun" for cost studies.

$$\frac{\text{vol. of ice cream} - (\text{vol. of mix} + \text{vol. of flavor})}{\text{vol. of mix} + \text{vol. of flavor}} \times 100 = \%\ \text{overrun}$$

   For example: when 40 gal. of unflavored mix is colored and flavored with 1.0 gal. of coffee extract and frozen to 77.9 gal. ice cream, then

$$\frac{77.9 - (40 + 1.0)}{40 + 1} \times 100 = 90\%\ \text{overrun}$$

3. Useful in determining the overrun on the plain mix used in making composite ice creams.

$$\frac{\text{vol. of ice cream} - (\text{vol. of mix} + \text{vol. of flavor})}{\text{vol. of plain mix}} \times 100 = \%\ \text{overrun}$$

For example: when 17.0 gal. of unflavored (plain) mix is colored and flavored with 3.0 gal. of maple nut and frozen to 40.0 gal. ice cream, then $\frac{40 - (17 + 3)}{17} \times 100 = 118\%$ overrun

MODIFICATIONS WHEN CALCULATING % OVERRUN BY WEIGHT[a]:

1. Useful for plain ice cream.

$$\frac{\text{wt. of gal. of mix} - \text{wt. of gal. ice cream}}{\text{wt. of gal. ice cream}} \times 100 = \%\ \text{overrun}$$

2. More correct and useful in evaluating "plant overrun"

$$\frac{\text{wt. of gal. of flavored mix}^{b} - \text{wt. of gal. ice cream}}{\text{wt. of gal. ice cream}} \times 100 = \%\ \text{overrun}$$

For example: when the flavored and colored mix weighing 8.85 lb. per gal. is frozen into ice cream that weighs 5.06 lb. per gal., then,

$$\frac{8.85 - 5.06}{5.06} \times 100 = 74.9\%\ \text{overrun}$$

3. Useful in determining the overrun on the plain mix used in making composite ice cream.

$$\frac{\text{wt. gal. flav. mix} - \text{wt. gal. ice cream}}{\text{wt. gal. ice cream}} \times \frac{\text{vol. plain mix} + \text{vol. flavor}}{\text{vol. plain mix}} \times 100 = \%\ \text{overrun}$$

For example: 17.0 gal. of plain mix is flavored and colored with 3.0 gal. of maple nut to give a flavored mix weighing 8.85 lb. per gal. When this is frozen into ice cream weighing 5.06 lb. per gal., then,

$$\frac{8.85 - 5.06}{5.06} \times \frac{17 + 3}{17} \times 100 = 0.749 \times 1.176 \times 100 = 88.1\%\ \text{overrun}$$

CALCULATING THE DESIRED OVERRUN FOR COMPOSITE ICE CREAM

The overrun at which to draw ice-cream is discussed in chapter XII. The Freezing Process. That discussion aids in establishing the correct overrun at which to draw plain ice cream and emphasizes the importance of the right amount of incorporated air in proportion to the amount of plain mix and the solids in the mix. When the most desirable overrun, or ratio of incorporated air to plain mix, has been established for plain ice cream, then the correct or corresponding overrun for composite ice cream can be calculated.

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[a] While these examples mention the weight per gallon, it is equally satisfactory to substitute the weight of any more convenient volume provided the same volume is used through the formula. This emphasizes the fact that these calculations are based on density measurements.

[b] The resulting blend of plain mix with coloring and flavoring material.

Composite ice cream drawn with too much overrun generally has body and texture defects described as "weak" and "fluffy," a common criticism of fruit and nut ice cream. This can be corrected by drawing a sufficiently lower overrun to obtain the same ratio of incorporated air to plain mix as is obtained in plain ice cream. This desired overrun is calculated as follows:

$$\left\{\begin{matrix}\%\text{ overrun used for}\\ \text{plain ice cream}\end{matrix}\right\} \times \left\{\frac{\text{gal. of plain mix}}{\text{gal. of flavored mix}}\right\} \times 100 = \%\text{ overrun for comp. ice cream}$$

PROBLEM 11:

What is the correct overrun at which to draw a composite ice cream containing 3.0 gal. of coloring and flavoring material added to 17.0 gal. of plain mix, if 90% is the desired overrun for plain Vanilla ice cream?

SOLUTION:

17 gal. + 3 gal. = 20 gal. of flavored mix.

Substitute in formula.

$(0.90) \times \frac{17}{20} \times 100 = 76.5\%$ overrun at which to draw the composite ice cream.

CALCULATING THE WEIGHT PER GALLON OF A MIX

When ten or preferably more cans are carefully filled with mix and weighed, the approximate weight per gallon can be obtained. However, a more accurate value can be calculated from the composition of the mix as illustrated by problem 12. Although temperature greatly influences the accuracy of this calculation, the following formula is considered sufficiently accurate at ordinary mix storage temperatures.

FORMULA No. VIII

$$\frac{8.33585}{\%\text{ fat } (1.07527) + (\%\text{ t.s.} - \%\text{ fat})\ (0.6329) + \%\text{ water}} = \text{lb. per gal. of mix}$$

PROBLEM 12:

Calculate the weight per gallon of a mix containing: 12.0% fat, 11.0% s.s., 15.0% sugar, 0.30% stabilizer, and 38.3% t.s.

SOLUTION:

Substitute in the formula

$$\frac{8.33585}{0.12\ (1.07527) + (0.383 - 0.12)\ (0.6329) + 0.617} = \text{lb. per gal. of mix}$$

$$\frac{8.33585}{0.12903 + (0.263)\ (0.6329) + 0.617} = \frac{8.33585}{0.12903 + 0.16645 + 0.617}$$

$$= \frac{8.33585}{0.91248} = 9.135 \text{ lb. per gal. of mix.}$$

CALCULATING WEIGHT PER PACKAGE

Calculating the weight per package of plain ice cream. Frequently it is important to know the correct weight of a package of ice cream when the ice cream contains the desired amount of overrun. This is readily obtained by adding the weight of the empty package to the calculated weight of ice cream per package. The formula assumes a one-gallon package, but any other size of package may be substituted.

FORMULA No. IX

$$\frac{\text{(wt. of 1.0 gal. of mix)}}{1.0 + \text{desired \% overrun}} = \text{wt. of ice cream per gal.}$$

Problem 13:

The mix weighs 9.135 lb. per gal. and the desired overrun is 90%. Calculate the weight of a gallon package which weighs 0.5 lb. when empty.

Solution:

substitute in the formula:

$$\frac{(9.135)}{1.0 + 0.90} = \frac{9.135}{1.90} = 4.808 \text{ lb. ice cream per gal.}$$

4.808 lb. ice cream
+ 0.50 lb. empty package

= 5.308 lb. = gross weight of the full package.

Calculating the weight per package of composite ice cream. When making composite ice cream, such as fruit and nut, it is desirable to take a lower overrun which will insure the same proportion of air to plain mix as is used in the vanilla or plain ice creams. The desired weight of composite ice cream necessary to maintain this same proportion of air to plain mix can be calculated as follows:

FORMULA No. X

$$\frac{\text{(weight of gallon of flavored mix)}}{1.0 + (\text{\% desired overrun}) \times \left\{\frac{\text{vol. of plain mix}}{\text{vol. of flavored mix}}\right\}} = \text{wt. per gal. ice cream.}$$

Problem 14:

The overrun used on plain (vanilla) ice cream is 90%. Maple nut ice cream is to be made using 3.0 gal. (24 lb.) of coloring and flavoring material to every 17.0 gal. of plain mix (9.0 lb. per gal.). What should be the weight of a one gal. package of the finished maple nut ice cream, if the empty package weighs 0.526 lb.?

SOLUTION:

(a) to find the wt. of gal. of flavored mix:

3 gal. flavor=24.0 lb.

17 gal. plain mix=17 × 9=153.0 lb.

---

20 gal. flavored mix=24.0 lb. + 153.0 lb.=177.0 lb.

1 gal. flavored mix=177 lb. ÷ 20= 8.85 lb.

(b)

$$\frac{\text{vol. of plain mix}}{\text{vol. of flavored mix}} = \frac{17 \text{ gal.}}{20 \text{ gal.}}$$

Substituting in the formula above:

$$\frac{(8.85)}{1.0 + (.90) \times \frac{17}{20}} = \frac{8.85}{1.765} = 5.014 \text{ lb.} = \text{wt. of 1.0 gal. of ice cream.}$$

then:

the empty gal. package=0.526 lb.

1.0 gal. finished ice cream=5.014 lb.

total wt. of package = 5.540 lb.

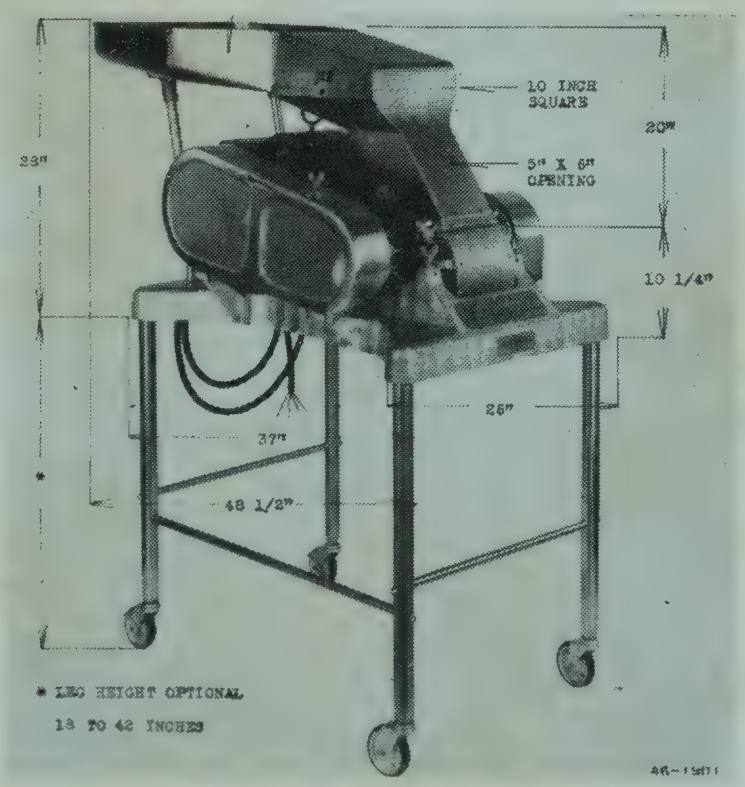
CHAPTER XI

MAKING AND PROCESSING THE MIX

In order to make good ice cream, the milk products and other ingredients must first be selected and combined so as to produce the desired body and a delicately blended flavor. Then they must be skilfully processed. Obviously the selection of good wholesome ingredients and calculation of a satisfactory composition, as discussed in previous chapters, precede the mixing of the ingredients in a vat where they can be heated to facilitate dissolving and blending.

ORDER OF ADDING INGREDIENTS

All liquid ingredients (cream, milk, condensed milk, syrup, etc.) are placed in the vat and the agitation and heating started at once. The dry ingredients, including skim milk powder, dried eggs, cocoa, sugar, and stabilizer (with few exceptions), are added while the liquid material is agitated and before the temperature reaches 120° F. Proper suspension to avoid lumpiness of the dry ingredients may be obtained by (1) mixing the dry material thoroughly with part of the sugar before slowly adding it to the

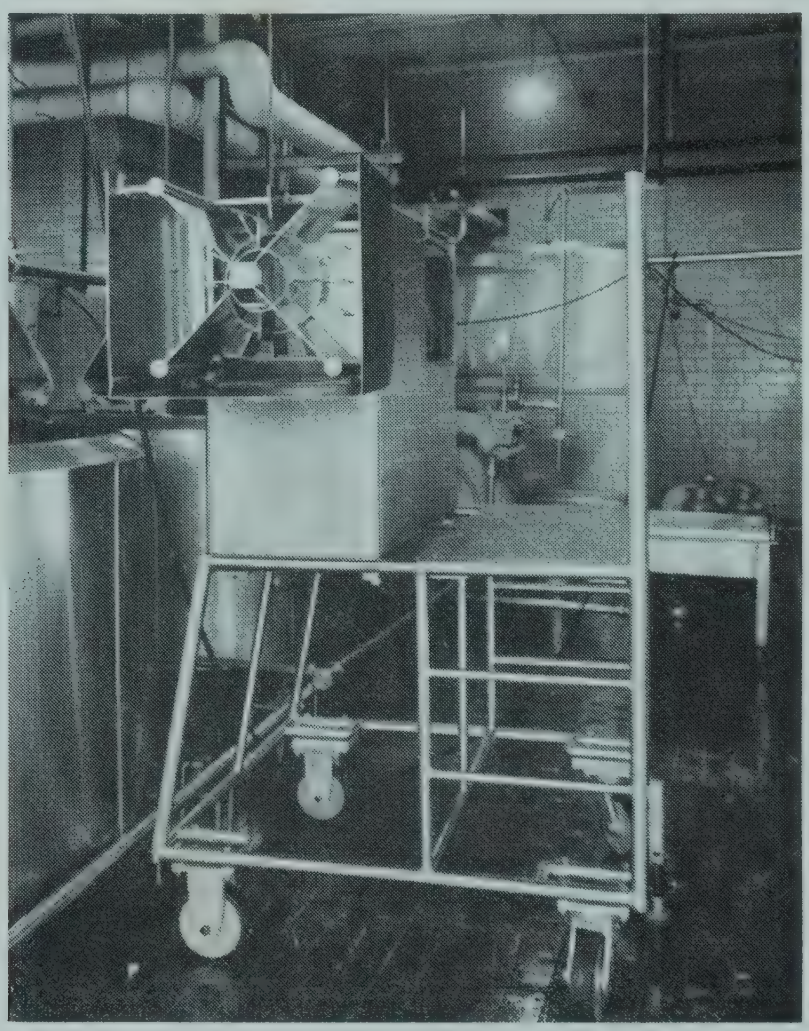


Courtesy, W. J. Fitzpatrick Co., Chicago

Fig. 10. Comminuting Machine for cutting into small pieces fresh or frozen products for the Ice Cream Mix.

liquid, or (2) sifting or otherwise slowly adding these substances to the liquid. Skim milk powder, cocoa, and similar products should be sifted on top of the liquid (in case a coil vat is used) at the place where the coils go down into the liquid, and always while the agitated liquid is still cool (under 80° F.). If gelatin is the stabilizer used it had best be added after it is thor-

oughly mixed with an equal volume of sugar and before the liquid reaches 120° F. Or it can be sprinkled on the surface of the cold liquid and allowed to soak before the mixture is heated. Another method is to soak the gelatin in water and then heat the mixture to completely dissolve the gelatin. This gelatin solution is usually added to warm (100°-120° F.) mix. Many other stabilizers such as Krageleen and C.M.C. can be added in a similar manner. However, sodium alginate, such as Dariloid, should not be added until the temperature of the liquid material has reached at least 150° F. The dry Dariloid is not allowed to soak but is stirred up with cold water and immediately



Courtesy, Bryant Machinery Company, Montclair, N. J.

Fig. 11. Bryant Hydraulic Comminuting Machine.

The business end of this machine is an arrangement of stainless steel knives which comminute frozen products such as cream, butter, eggs, etc., as these products are forced into these knives from a cylinder, by the action of a hydraulic ram and a piston. By removing one pin these knives are completely disassembled for cleaning. In operation the knives are stationary.

dumped into the hot mix. When butter, plastic cream, frozen cream or other frozen products are used, they should be cut into fairly small pieces and added in time to allow complete melting before the pasteurizing temperature is reached. With a few exceptions, coloring and flavoring materials are added at the time the mix is frozen.

NEUTRALIZING AND STANDARDIZING THE ACIDITY

The Need for Neutralizers. When fresh sweet dairy products of excellent quality are used, the mix will have only the normal desirable acidity due to the proteins, mineral matter, and dissolved gases which it contains, and it is not necessary to add neutralizers. This normal acidity is desirable because it contributes to the natural, palatable flavor of milk, cream, ice cream and helps to prevent the development of bitter flavors in ice cream. It is not to be confused with the lactic acid (excess acidity) which develops as a result of the breakdown of the milk sugar by the action of lactic acid bacteria. When dairy products of such excellent quality are not available, or are not used, it is not as easy, if not impossible, to make a mix of finest quality, but a good marketable ice cream can be made either by making certain changes in the manufacturing procedure, or by adding enough neutralizer, if laws permit, *i.e.,* sodium bicarbonate (common baking soda), calcium hydroxide (lime), or magnesium lime, to reduce the excess acidity which has developed in the milk or cream.

Mixes made with products containing excessive amounts of developed acidity may curdle slightly and the resulting ice cream will have a feathered appearance when melted. These mixes frequently develop excessive viscosity, especially if homogenized, and are somewhat difficult to whip and handle. Reducing the homogenization pressure may overcome this defect when it is not too serious. The curdling can usually be observed as the mix passes over the cooler.

Bicarbonate of Soda as a Neutralizing Agent. The normal acidity of the mix varies with the percentage of serum solids it contains and may be calculated by multiplying the percentage of serum solids by the factor, 0.018. Thus a mix containing 8 per cent serum solids would have a normal acidity of 0.144 per cent. If the acidity of the mix is more than 0.02 or 0.03 greater than its calculated normal acidity, the acidity should be standardized to, but not below, the calculated normal acidity. If the amount of excess acidity is small, bicarbonate of soda is very satisfactory for neutralization. It increases the viscosity less than other neutralizers, is very soluble, affects the flavor very little, and is always available. The bicarbonate of soda should be dissolved in five times its weight of water and sprinkled slowly into the mix while the mix is being agitated at a temperature of 90° to 100° F. This temperature should be held for five to ten minutes before the heating is continued to the pasteurization temperature. The process of standardizing the acidity requires careful calculation and operation in order to avoid the more objectionable defects resulting from improper neutralization. Reducing the acidity to the calculated desired value by adding sodium bicarbonate will permit the use of the usual homogenizing pressures, tend to reduce viscosity, and improve whipping ability. Directions for making the acidity test are

given in Chapter XXI and directions for calculating the amount of neutralizer to use are given in Chapter X.

Lime neutralizers have a more desirable influence on the flavor but a less uniform effect upon the homogenizing pressures, the viscosity and the whipping ability of the mix. This may be explained by the fact that during the souring process certain constituents (notably lactose and citrates) are changed, and these changes frequently are not corrected when neutralizers are added. Thus some neutralized mixes whip more slowly than untreated mixes of the same acidity. Similarly, some neutralized mixes seem to be more susceptible to the ice cream defect known as shrinkage.

Table 16, from The Butter Industry, 3rd edition, by Dr. O. F. Hunziker, shows the correct amount of dry neutralizer to use in making up 10 gallons of neutralizer solution of the correct neutralizing strength. The neutralizers given in the table are those commonly used in the dairy industry.

TABLE 16. AMOUNT OF DRY NEUTRALIZER REQUIRED FOR 10 GALLONS OF NEUTRALIZER STOCK SOLUTION [a]

Group and Brand of Neutralizer	Pounds of Dry Neutralizer Required for 10 Gallons of Neutralizer Solution
Low Magnesium lime (less than 5% MgO, such as Peerless lime	24
Medium-Magnesium limes (30 to 35% MgO), such as Kelley Island, Neutra-Lac, Neutra-Lime	20
High-Magnesium limes (40 to 55% MgO), such as Allwood lime	14.6
K. & M. Magnesium oxide lime	16
K. & M. Magnesium carbonate lime	32
Sodium bicarbonate (baking soda)	46
Sodium carbonate (soda ash)	33
Mixtures of baking soda and soda ash, such as sodium sesquicarbonate, Neutralene, Nat'l. Neut.	41
Wyandotte C.A.S.	38

[a] For detailed information regarding the amount and how to use see Chapter X on Calculations.

To sum up, it may be said that both soda bicarbonate and the lime neutralizers will reduce high acid in cream, thus making it possible to produce a satisfactory ice cream—a better product than would be possible without their use.

PASTEURIZATION OF THE MIX

Making Ice Cream Without Pasteurizing the Mix. Where not required by city or state health regulations pasteurization of the mix is not essential to the production of ice cream and other frozen dairy products, but it is always desirable. The stabilizer, however, must first be dissolved in warm water or warm, sweet skim milk, then cooled and added to the dairy prod-

ucts together with the sugar. The sugar and especially the syrups require thorough agitation because they blend very slowly with the cold mix.

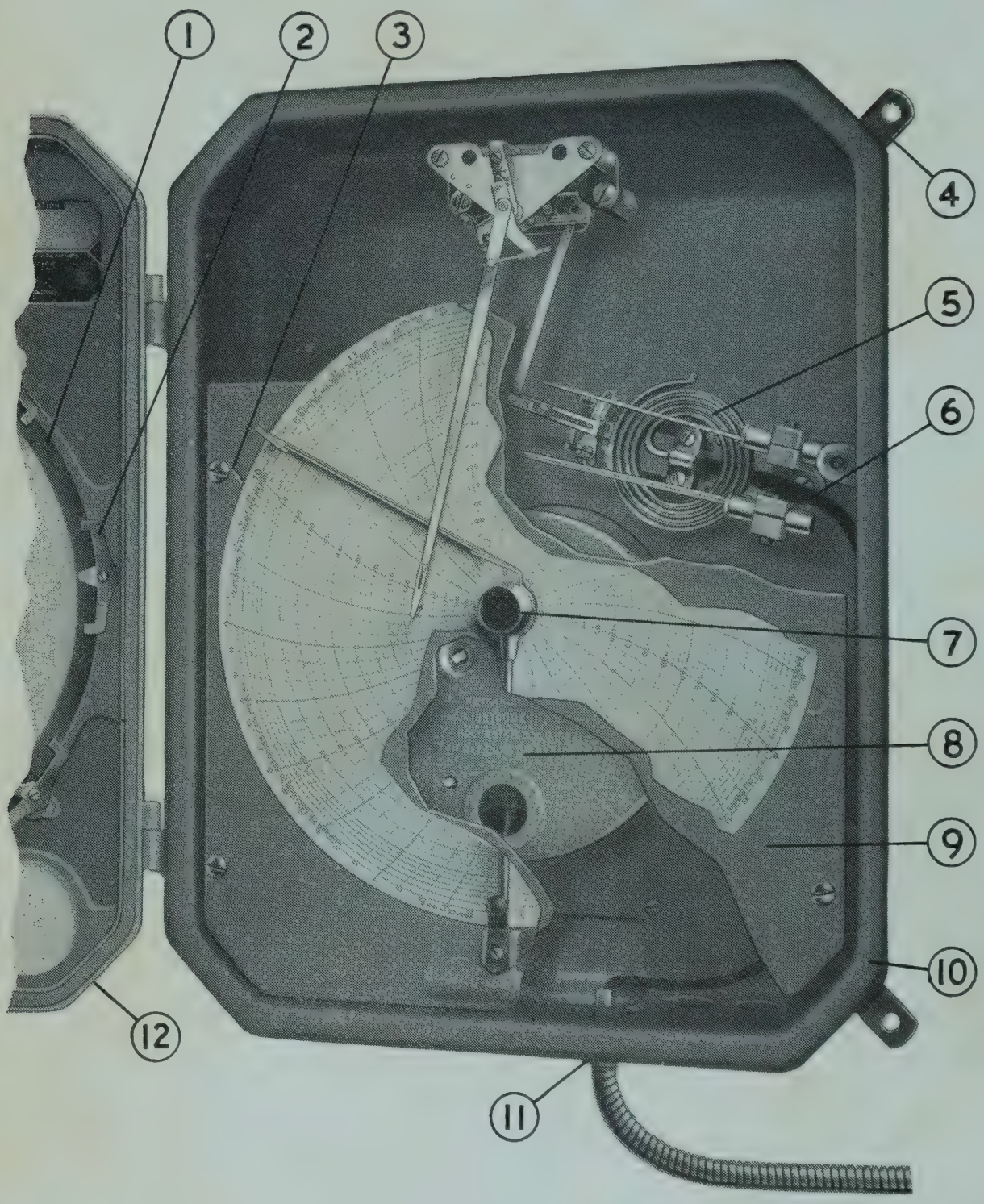
This method, however, is usually not practiced because it increases the whipping ability too much, and often results in poor blending of ingredients. When the dairy products are not pasteurized it generally follows that they are not homogenized, hence the resultant ice cream is coarser in texture and may even contain lumps of butter due to partial churning in the freezer. A further objection is that unpasteurized dairy products, including the ice cream mix, may contain large numbers of bacteria, some of which may be pathogenic.

Compulsory Pasteurization. Proper pasteurization of all mixes should be compulsory because this process destroys all pathogenic or disease-producing bacteria, thereby safeguarding the health of the consumer. Pasteurization has come to be considered highly desirable and requires only slight additional expense, since the mix is usually heated to facilitate solution, and since the homogenization process can be best accomplished at the pasteurization temperature level.

Most states and many cities specify certain definite temperature regulations when pasteurization is required but these generally apply only to the dairy products used. Usually it is permissible to use higher temperatures for pasteurization than are required for market milk, and in many instances it is legal to re-pasteurize products which have already been pasteurized once. Every manufacturer should acquaint himself with the legal regulations which apply in his market area and make special note of the following:

1. What dairy products if any may be used without being pasteurized.
2. The maximum bacteria count of ingredients used even when followed by pasteurization.
3. The pasteurization time and temperature requirements.
4. The maximum permitted bacteria count of the finished product. (Usually it is different for ices, ice cream, etc., as well as for products which are not pasteurized, than for those which are pasteurized.)
5. Must the product be frozen on the premises where it is pasteurized?

Proper pasteurization consists in rapidly heating to a definite temperature, holding at that temperature for a definite minimum of time, and then rapidly cooling to below 50° F. At holding temperatures of 145° - 150° F. the holding time should be at least 30 minutes. The tendency within the industry is to pasteurize at temperatures of 160° - 170° F. and hold for 30 minutes even though some regulations permit a slightly shorter holding time for these temperatures. The use of these higher temperatures increases the cost of heating and cooling and may produce a cooked flavor, but has several ad-



Courtesy, Taylor Instrument Co.

Fig. 12. Taylor Retard Recording Thermometer for Pasteurization.

1. Rubber Gasket. 2. Eight Guides attached to door. 3. An arc to aid in locating pen-point. 4. Mounting Brackets. 5. The Tube System. 6. Retard Wires. 7. Pen Lifter. 8. Spring-wound Clock. 9. Chart Plate. 10. Case. 11. Connecting Tube. 12. Door Gasket.

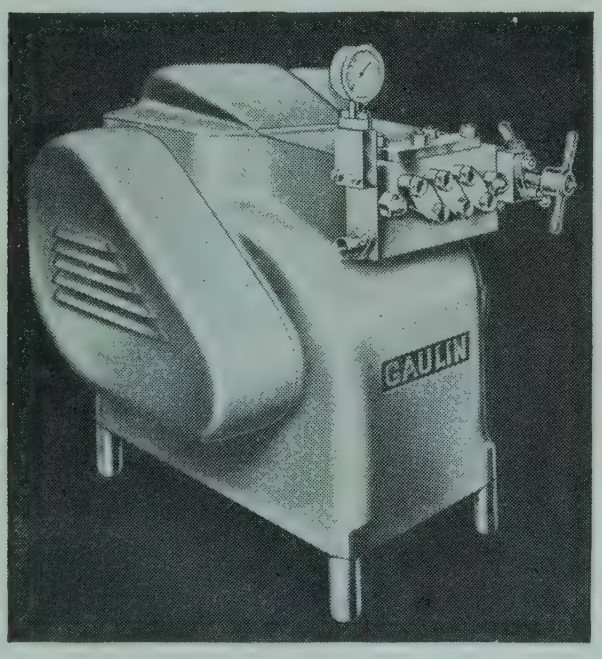
vantages, such as a lower bacteria count, better keeping quality of the mix, and lower viscosity with less fat clumping.

When the mix is not homogenized, the pasteurization may be completed in the vat used for mixing the ingredients. Since most mixes are homogenized, the mix is usually heated and held before going to the homogenizer and from there passes over a cooler. The heating and holding may be

accomplished in the vat used for mixing the ingredients. Some large factories make use of continuous pasteurizers and profitably incorporate the regeneration principle. This principle employs the use of the cool mix, which is being heated, as a cooling medium for the hot mix coming from the homogenizer. Specially constructed equipment is necessary for efficient and sanitary operation.

HOMOGENIZING THE MIX

Homogenization is accomplished by passing the mix through a very small opening under a high velocity and usually a high pressure. The machines known as "viscolizers" and "homogenizers" employ positive piston pumps to force the mix at high pressure through a minute valve opening. The principal difference between these machines is not in the effect produced but in the size of the aperture through which the mix passes. A pressure of



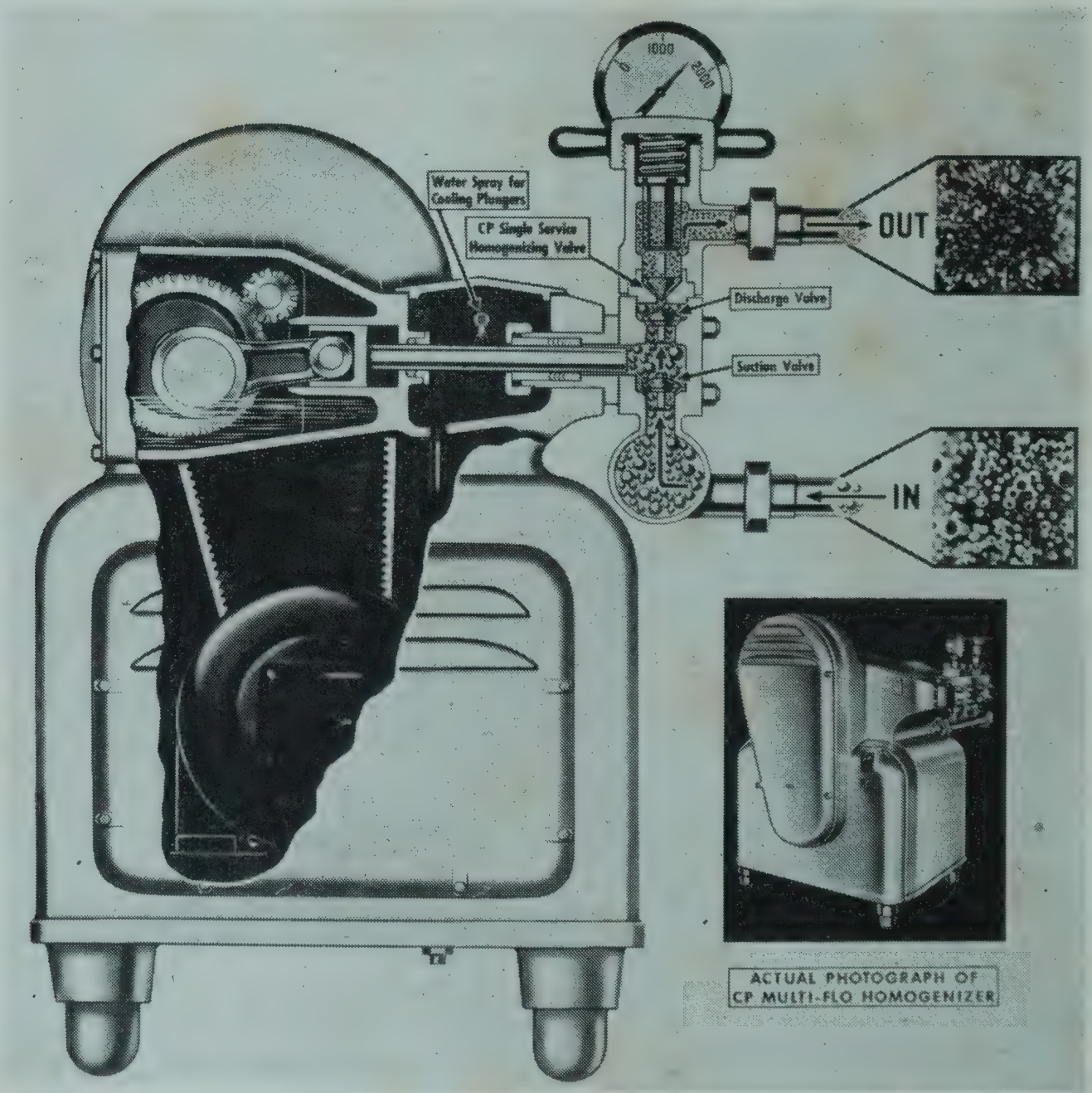
Courtesy, Manton-Gaulin Mfg. Co.

Fig. 13. Manton-Gaulin Homogenizer

2000 pounds on the viscolizer is equal to approximately 3000 on the homogenizer; at these pressures the size of the aperture is 0.003 and 0.007 inches, respectively. Rotary machines, another type, are available for this process but these generally require a more skilled operator to keep them working at top efficiency.

The main purpose of homogenization is to make a permanent and uniform suspension of the fat by reducing the size of the fat droplets to a very small diameter, preferably not more than 2 microns. This means that when a mix is properly homogenized, the fat will not rise and form a cream layer. Other advantages are also obtained, such as a more uniform ice cream with a smoother texture, improved whipping ability, a shorter aging period, less opportunity for churning to occur in the freezer, and the use of slightly less stabilizer. Butter, butter oil, plastic cream, and frozen cream can be used in the mix only when the mix is homogenized.

Physical Effects of Homogenization. The process of homogenization is assumed to affect the mix only physically. The fat globules are reduced to about 1/10 the normal size which increases the total surface of the globules about 100 times. Therefore, it is easy to see why homogenization produces effects which differ considerably with varying composition, acidity, temperature, pressure, *etc.* The substances in colloidal and true solution tend to be concentrated on the fat globule surfaces. Varying conditions will have different effects on the films forming at these surfaces. There is a tendency for fat globules to form in groups as the mix passes away from the homogenizing valve. This is particularly true of the butter and frozen cream types of mixes, of cold mixes, or of acid mixes. This clumping of the fat globules, if marked, causes excessive viscosity and slow whipping. For this reason some homogenizers are equipped with a second valve which



Courtesy, Creamery Package Mfg. Co.

Fig. 14. Diagrammatic illustration of CP Multi-Flo Homogenizer

breaks up the clumps; in other words, the mix passes through one valve (called the first stage) under a high pressure (above 1000 pounds) where clumping may occur and then through another valve (called the second stage) under a low pressure (500-1000 pounds is sufficient) where the clumps are broken up, and then the mix passes out of the homogenizer toward the cooler.

Homogenizing Temperatures. The mix is usually homogenized at temperatures from 145° - 170° F. because at low temperatures (120°-130° F.) homogenization increases the formation of clumps of fat globules, increases the viscosity, and increases the freezing time in batch freezers. When using a high pasteurizing temperature (170° F.) the mix may be cooled to 150° F. for homogenization, a desirable practice to reduce the intensity of a cooked flavor and the length of time the mix has to be held at the high temperature especially when homogenization is not completed in 30 minutes. However, within certain limits, better homogenization is obtained with each increase in the temperature used, and sometimes the mix is pasteurized at 145° F. and then heated to 160°-170° F. for homogenization. The use of these high temperatures results in less clumping of the fat globules, a lower viscosity, and a shorter freezing time in batch freezers.

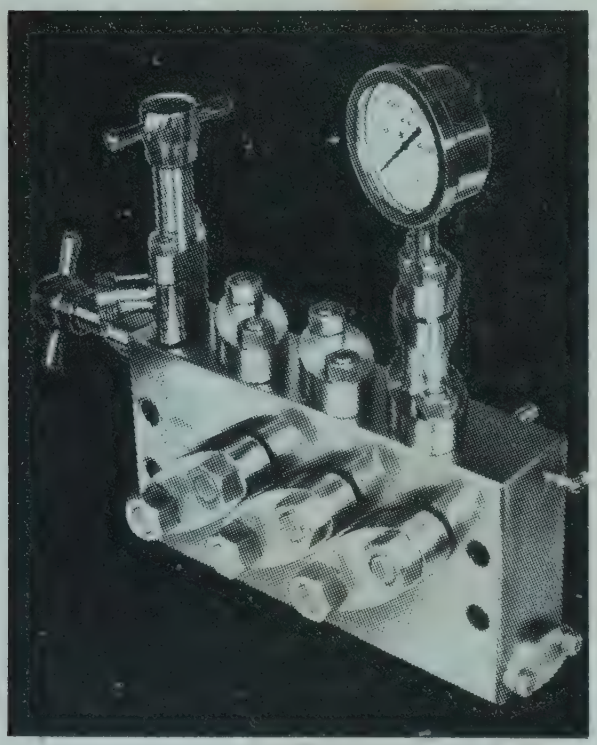
Pressures for homogenization. The pressure to use for homogenization depends upon several factors: desired viscosity, composition of the mix, stability of the mix, temperature used, and construction of the homogenizing machine. Because of the influence of each of these factors, one can recommend only a range of pressures, realizing that a specific case may require pressure above or below the range. A pressure of 2000 to 2500 pounds with one valve or 2500 to 3000 pounds on the first stage and 500 pounds on the second stage will usually give good results for an average mix. Chocolate mixes and other high solids mixes usually have sufficient viscosity if the pressure is reduced about 500 pounds (*i.e.* 1500 to 2000 pounds for single stage and 1500-2000 pounds on the first valve with 500 pounds on the second valve in two-stage homogenization). The same is true for mixes using butter, plastic cream, *etc.*, as the only source of fat; or concentrated products as the only

Table 17. Approximate Homogenization Pressures for Mixes of Different Fat Content

	Single stage	Double stage	
		First valve	Second valve
8 to 12% fat	2500 to 3000 lb.	2500 to 3000 lb.	500 lb.
12 to 14% fat	2000 to 2500 lb.	2000 to 2500 lb.	500 lb.
15 to 17% fat	1500 to 2000 lb.	1500 to 2000 lb.	500 lb.
18% fat	1200 to 1800 lb.	1200 to 1800 lb.	500 lb.
above 18% fat	800 to 1200 lb.	800 to 1200 lb.	500 lb.

source of serum solids. The pressures in Table 17 are suggested only as an approximation for mixes containing different percentages of fat.

Causes of Fluctuating Pressures. When operating a homogenizer the needle of the pressure gauge should be steady and should not oscillate, should not change markedly unless the valve wheel is turned, and should change whenever the valve wheel is turned. Failure of the pressure gauge to respond to the turning of the wheel on the homogenizer valve may be caused by a plugged line to the gauge, by slipping of the belt, by packing or similar material being caught under the homogenizing valve, or by a worn valve. When the gauge pressure changes without the turning of the valve wheel, one should look for a slipping belt, material such as packing under the homogenizer valve, or a loose spring under the valve wheel. Sometimes the change in gauge pressure may be caused by heat expanding the metal and producing a change in the space between the valve and valve seat. Oscillation of the gauge pressure may be due (1) to an uneven



Courtesy, Cherry-Burrell Corp.

Fig. 15. Superhomo—Cylinder Block Assembly (front view).

1. The entire cylinder block including fittings are of stainless steel.
2. For simplicity, all parts are assembled and disassembled from the front.
3. All adjustments to gaskets and plunger seals are made at the front end and on top of the cylinder block. Tightening is by HAND or the use of a SHORT wrench.
4. For ease of handling, all parts that are removed for cleaning are small in size and light in weight.
5. Cleaning and assembly time is shortened by one-third.
6. The pressure gauge is sanitary, waterproof, accurate, and can be positioned at any angle.

amount being pumped by each valve because of the strainer being clogged or air leaks in the suction line, or (2) to anything that allows mix to pass back by the valves into the machine head (such as slipping belt, pumping valves opening too wide and not closing promptly, or valve surfaces damaged by wear or scores). Air leaks in the suction line may be caused by scratches on the surface of the joints in the pipe lines, and therefore the pipes should be carefully handled. Moving parts such as pump pistons passing through packing may be slightly grooved or the packing may become old and cause small pieces of packing to break off into the mix eventually sticking in the small valve openings. Thus the need of extreme care in handling equipment is emphasized.

Factors which favor high viscosity and clumping of the fat globules are: (1) high pressures with a single valve, (2) low temperature of mix when homogenized, (3) low stability of the mix due to high acidity or improper salt balance, and (4) a high ratio of the fat content to the serum solids content (*i.e.* with a high fat content and low serum solids content). The easiest and most convenient way to reduce the viscosity produced by homogenization is to use lower pressures, especially when homogenizing mixes of low stability. The use of higher temperature during homogenization will also reduce the viscosity and fat clumping. Standardizing the acidity is effective especially when the viscosity is due to high acidity in the mix. The use of a second valve is especially effective in reducing the clumping of the fat globules and reducing the excessive viscosity produced by this phenomenon.

Detection of defective or improper homogenization can be accomplished by examining a sample of the mix with a microscope. This enables an experienced technician to measure the size of the fat globules and detect clumping. Another method such as that used for homogenized milk is simpler but less accurate, and requires less experience on the part of the operator. In this method a quart milk bottle is filled with mix and stored at 40° F. for 48 hours. Then without agitation the top 80 to 100 ml. are quickly poured off into a graduated cylinder. Each portion (the portion poured off and the portion remaining in the milk bottle) is separately mixed and tested for fat content. The difference between the tests of the two portions should be less than 0.7 per cent if the mix has been properly homogenized.

Care of working parts of the machine. Since the working parts of the homogenizer are enclosed, special care of the machine is necessary to prevent bacterial contamination by the homogenizer. It should be taken down frequently, preferably after each use, and left apart until reassembled for immediate use. In this way the parts remain dry. The machine should be flushed out thoroughly with hot water before it is used. The valves should be ground occasionally and kept free from scores.

MAKING THE MIX IN A VACUUM PAN

A vacuum pan is sometimes used in making extremely large quantities of ice cream mixes, and is also used in making condensed and powdered ice cream mix. These procedures require large investments and present a few special problems. Discussion of these problems is omitted here because of the relatively small amount of product handled in this manner.

COOLING THE MIX

Cooling the mix immediately to 32°-40° F. is essential, after which it should be held in jacketed aging tanks until melted. Unless the mix is

cooled to a temperature of 50° F. or lower, it will become very viscous and the ice cream will not melt down smoothly. Also, temperatures below 50° F. inhibit the growth of bacteria.

Coolers of the surface or cabinet types are generally used for ice cream mix, as the product is too viscous to be cooled effectively in the internal tubular cooler. The surface cooler should be so constructed that moisture condensation forming on the ends of the tubes cannot flow into the mix or drop into the lower trough. The cabinet cooler, which is essentially a battery of small surface coolers, works very satisfactorily with ice cream mix if the temperature of the brine used in cooling is held between 20° and 25° F. or slightly higher. In some factories which handle mixes of lower viscosity the modern plate coolers are being used successfully.

AGING THE MIX

Aging the mix before freezing has been practiced since the inception of the ice cream industry.

The changes wh ch undoubtedly occur during aging are:

1. The fat is solidified.
2. The gelatin swells and combines with water.
3. The proteins of the mix may change slightly.
4. The viscosity is increased, largely due to the previously mentioned changes.

There is no question but that smoothness of body and texture, resistance to melting, and ease of whipping are improved by aging. How much time is necessary for the realization of these advantages is the question. Until recently, the generally accepted time for aging the mix was about 24 hours. Recent experimental work seems to prove that under the average commercial conditions 3 or 4 hours of aging is all that is essential unless the freezing equipment is in poor condition. Then a longer aging period seems to give better results. With high fat mixes which have been homogenized at very low pressures, 24 hours of aging produce good results.

The aging temperature should not exceed 40° F. Many plants age the mix around 36° F. or a little lower. At these temperatures, the bacteria count will not increase during aging. Aging temperatures as low as 28° to 30° F. are sometimes used. There seems to be no advantage in this; in fact, there is the danger that the first of the mix to enter the freezer might freeze fast to the cold walls of the freezer and tend to twist the dasher.

When the mix has been properly aged it is ready for the freezing process which generally follows immediately. Holding the mix for more than about five days is likely to cause at least some deterioration in both flavor and quality.

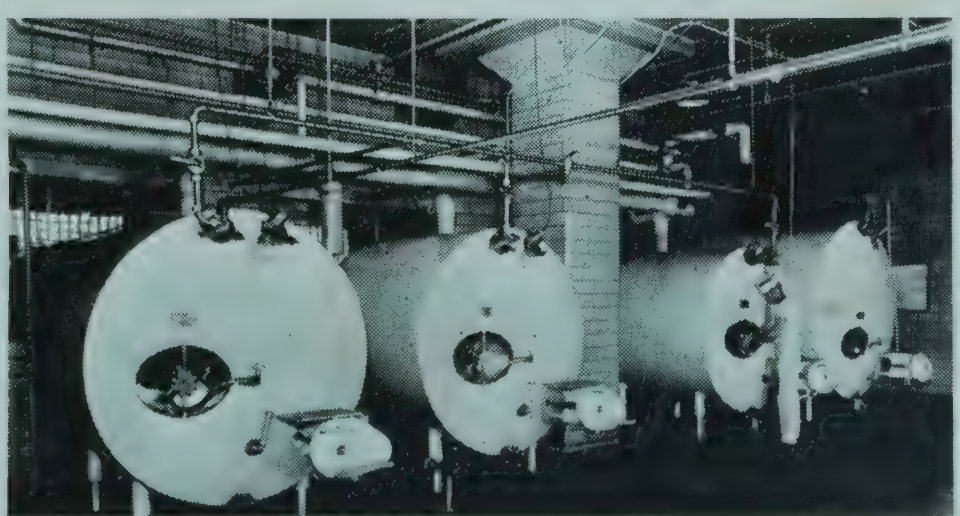
CHAPTER XII

THE FREEZING PROCESS

Freezing the mix is one of the most important operations in the making of ice cream for upon it depend the quality, palatability, and yield of the finished product.

The freezing process may for convenience be divided into two parts: 1. The mix, with the proper amount of color and flavoring material generally added at the freezer, is quickly frozen while being agitated to incorporate air in such a way as to produce and control the formation of small ice crystals so necessary to give smoothness in body and texture, palatability, and satisfactory overrun in the finished ice cream. 2. When the ice cream is partially frozen to a certain consistency it is drawn from the freezer into packages and quickly transferred to cold storage rooms where the freezing and hardening process is completed without agitation. Changes that take place in the hardening room are discussed in Chapter XIII.

The general procedure of the freezing process is easily learned since it involves only accurate measurement of the ingredients into the freezer where they are agitated and frozen only to a certain consistency and then removed from the freezer. However, the correct handling of the details to produce a uniform product requires expert judgment and almost split-second timing —a technique acquired only through experience guided by continual, careful study. In fact it is very seldom that any two people will execute the details in exactly the same manner and therefore they obtain different ice creams even when using the same ingredients, formula, and equipment. The effect of slight variations in the amount of coloring and flavoring materials which are usually added at the freezer is readily observed, but equally important are the variations in details of operation.



Courtesy, Fairmont Foods Co., Omaha, Nebr.

Fig. 16. Storage Coolers for Ice Cream Mix.

CLASSIFICATION OF FREEZERS

I. Batch freezers
   a. Salt and Ice type
      1. Hand power, vertical tub freezers today used only in the home.
      2. Power driven, vertical, now used only in isolated areas.
   b. Brine freezers.
      1. Vertical—now used mostly in some makes of Counter Freezers.
      2. Horizontal—rapidly becoming obsolete.
   c. Direct Expansion (refrigerant)
      1. Vertical—used mainly in some Counter Freezers.
      2. Horizontal—widely used in modern factories, at least for special purposes.

II. Continuous freezers
   Horizontal, direct expansion; rapidly replacing batch freezers especially in large plants.

IMPORTANCE OF THE FREEZER

Fast freezing is essential for a smooth product because ice crystals that are formed quickly are smaller than those formed slowly. Therefore it is desirable to freeze and draw from the freezer in as short a time as possible. A continuous freezer accomplishes this in a few seconds while batch freezers use six to ten minutes depending on factors mentioned later. Also, since freezing continues after the ice cream is placed in the hardening rooms, the ice crystals formed during the hardening period are larger because they form more slowly than in the freezer. For this reason it is desirable to freeze the ice cream as stiff as possible and yet have it liquid enough to draw out of the freezer.

Factors influencing the freezing time (time the mixture is in the freezing chamber of the freezer) are of two types. Some are mechanical while others are inherent in the mix itself. Some **mechanical factors** which influence the freezing time include:

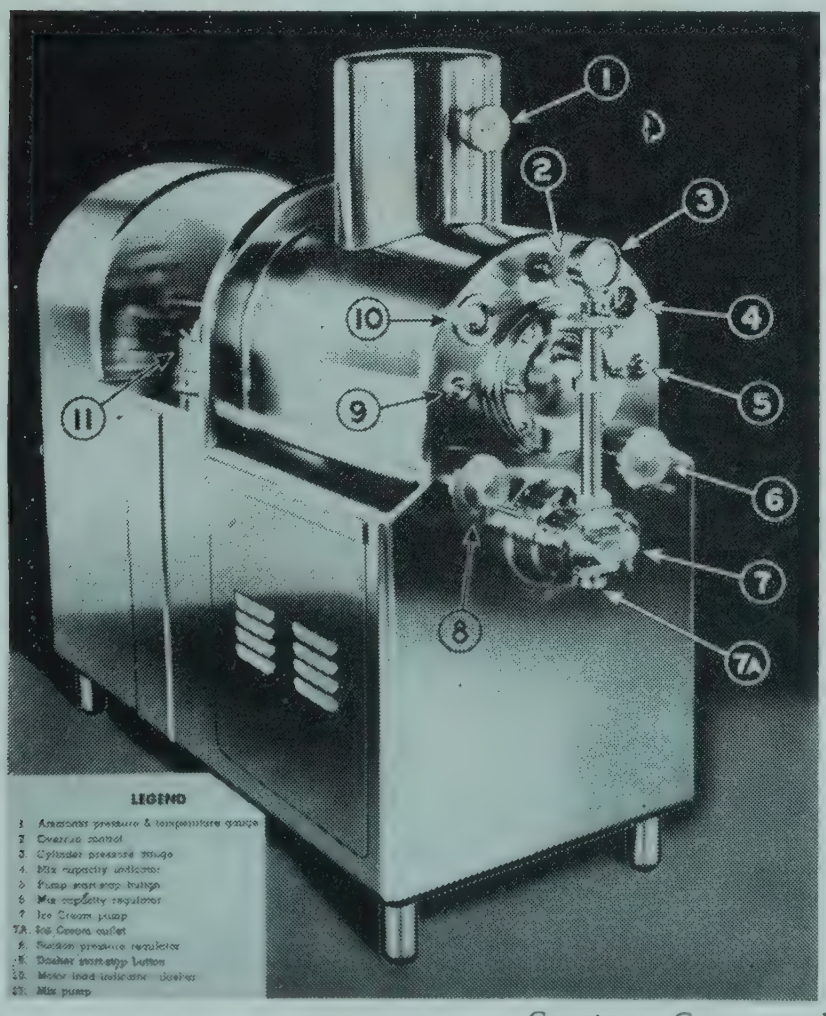
1. Type and make of freezer.
2. Condition of freezer wall and blades.
3. Speed of dasher.
4. Temperature of refrigerant.
5. Volume of refrigerant passing around freezing chamber.
6. Overrun desired.
7. Temperature at which ice cream is drawn.
8. Rate of unloading freezer.

Character of the mix also influences freezing time. Some of the main considerations here are:

1. Composition of the mix.
2. Freezing point of the mix.
3. Acidity content of ingredients.
4. Kind of ingredients, particularly those carrying fat.
5. Methods of processing the mix.
6. Kind and amount of flavoring materials added.

Changes that take place in the freezing chamber of a freezer. The temperature of the mix which is put into the freezer drops very rapidly while the sensible heat (which thermometers measure) is being removed and before any ice crystals are formed. This process should take less than a minute or two. Meanwhile, the rapid agitation reduces the viscosity by partly destroying the gel structure and by breaking up the fat globule clusters. The gel structure may partially re-form during the hardening process in the hardening room. Also, the rapid agitation hastens incorporation of air into the mix.

When the freezing point is reached, the liquid water changes to ice crystals which appear in the mix. The ice crystals are practically pure wa-



1. Ammonia pressure and temperature gauge
2. Overrun control
3. Cylinder pressure gauge
4. Mix capacity indicator
5. Pump start-stop button
6. Mix capacity regulator
7. Ice cream pump
7a. Ice cream outlet
8. Suction pressure regulator
9. Dasher start-stop button
10. Motor load indicator-dasher
11. Mix pump

Courtesy, Creamery Package Mfg. Co.

Fig. 17. CP Continuous Freezer.

ter in a solid form, and thus the sugar, as well as other solutes, becomes more concentrated in the remaining liquid water. Increasing the concentration of these solutes causes the freezing point of the liquid portion to be slightly lower so that the temperature (or sensible heat as it is called) must be lowered before more ice crystals will form. However, the heat called **latent heat of fusion** that must be removed to change liquid water into solid ice crystals is not measured by the thermometer, so that the temperature of the mix would not change noticeably while ice crystals are forming. This actually happens when pure water is frozen, but in freezing ice cream the freezing point is continually being lowered by the formation of the ice crystals, so that the temperature continues to drop but at a slower rate than during the first minute or two while approaching the initial freezing point. While the temperature drops more ice crystals are formed, increasing the concentration of sugar and other solutes in the remaining liquid water until the concentration is so great that freezing will not occur, thus all of the water is not frozen even after long periods in the hardening room.

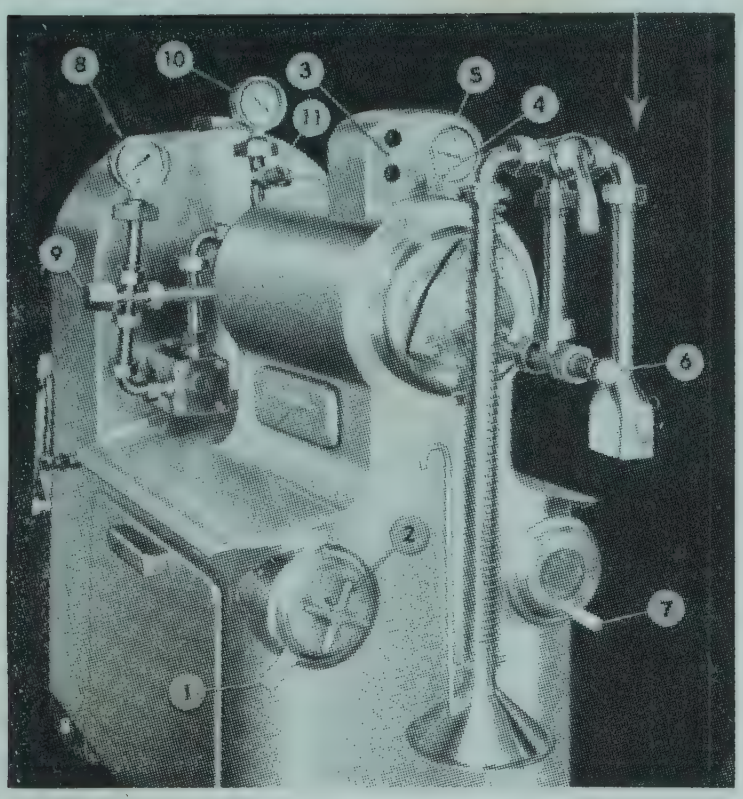
During this period in the freezer while the ice crystals are forming, more air is incorporated into the mix, and such ingredients as acid fruit juices, fruits, or nuts may be added without any danger of coagulating the mix. Also, at this time the refrigerant may be shut off the batch freezers. Agitation, in hand or home freezers, is usually stopped when the product has reached a certain consistency or stiffness. This point depends upon the amount of water already changed into ice crystals, and the amount of air incorporated into the mix. In commercial freezers, when this point is reached the ice cream is drawn out of the freezers into packages to be placed in the hardening room. At this time, the ice cream contains the desired amount of air, but not all of the desired amount of ice crystals.

THE CONTINUOUS FREEZER

The principle of the continuous freezer process was first patented in 1913 but did not become widely used until 1930 to 1935. Briefly described, the process consists of continually feeding into one end of the freezing chamber a metered amount of ice cream mix and air. As the mixture passes through the freezing chamber it is agitated and partially frozen and then discharged in a continuous stream of about the same consistency usually obtained from a batch freezer. This partially frozen stream is delivered into packages which are then placed in the hardening room to complete the freezing process. The modern machines for this purpose are known as "continuous" or "instant" freezers.

Some important advantages of the continuous method are:

1. Less stabilizer is needed, because a larger amount of the ice crystals



Courtesy, Cherry-Burrell Corp.

Fig. 18. Vogt Instant Freezer.

1. Refrigeration on and off control. 2. Back pressure control valve operating handle. 3. Motor start and stop switches. 4. Overrun control knob. 5. Back pressure gauge. 6. Hold back control. 7. Variable speed control. 8. Mix pressure gauge. 9. Mix pressure relief valve to protect gauge. 10. Vacuum gauge. 11. Air valve.

can be formed in the freezer instead of in the hardening room where slow freezing gives larger crystals, and because less viscosity is needed in the mix.

2. A shorter aging time is possible because less viscosity is needed and the incorporation of air is less dependent upon the character of the mixture.

3. Less flavoring material is needed because the smaller ice crystals melt more rapidly in the mouth and make the flavor slightly more pronounced.

4. Smoother ice cream is obtained because the ice crystals are much smaller and more uniformly small, and fewer larger crystals are formed in the hardening room.

5. There is less tendency toward sandiness because rapid freezing favors small lactose crystals.

6. A more uniform yield is obtained with less variation between packages, especially when small packages are filled.

7. Continuous freezing facilitates the making of specialties such as center molds, special shapes, combinations of different flavors or colors in one package, variegated ice creams, individual serving-sized package, *etc.*

8. The volume of ice cream frozen per man-hour of labor is increased. This is most pronounced in packages of the one-pint or one-quart size. There is no saving when filling packages smaller than one pint.

9. There is less opportunity for contamination when filling packages and specialties.

Some disadvantages of the continuous method are inherent in the process while others may eventually be eliminated by better engineering:

1. Great care should be taken in handling the parts of the machine which must fit properly with very small clearances.

2. Operator and mechanics must have special experience and training in order to avoid operational difficulties and possible damage to equipment.

3. It is too easy to obtain excessive overrun.

4. There is a greater tendency for ice cream to shrink in volume after hardening. However, research on this problem may indicate that changing the composition of the mix will correct this difficulty.

5. More helpers are needed to bring supply of containers and carry away the filled packages.

6. Initial cost of this more elaborate equipment is high.

7. At present the capacity of continuous freezers requires a rather large volume of business to make their use economical.

THE BATCH FREEZER

The dasher which fits into the freezing chamber and can be easily removed for cleaning is an important part of every batch freezer. In the batch freezer it consists of two parts, the scraper blades and the beater, to perform the following functions:

1. Aids in transmission of refrigeration by keeping the mix in continuous contact with freezer walls.
2. Scrapes freezer walls free from ice crystals.
3. Beats in air.
4. Pushes mix continually forward which is essential in unloading the freezer.

It is important to have the dasher in proper alignment and the blades must be sharp.

The temperature of the refrigerant is very important and should be from −10° to −20° F. in order to get a rapid formation of ice crystals. This rapid formation favors the development of small crystals and results in a smoother ice cream. However, the freezing should be slow enough to permit incorporating the desired amount of air, since this also affects the body and texture of the ice cream. The most desirable refrigerant temperature to use depends upon:

1. The efficiency of the freezer.
2. The freezing point of the mix (dependent upon the amount of serum solids, sugar, and flavoring material present).
3. The sharpness of the scraper blades.
4. The amount of refrigerant available.

In the direct expansion freezers, the freezing chamber is surrounded by

liquid ammonia or other refrigerant. This type of freezing medium has now nearly replaced other types for both the batch and continuous freezers in ice cream factories because it is cheaper[a] due to saving in power and equipment, as well as increasing refrigeration capacity. The saving in power results from no brine to pump and smaller compressors operating at higher suction pressures. (See Table 18)

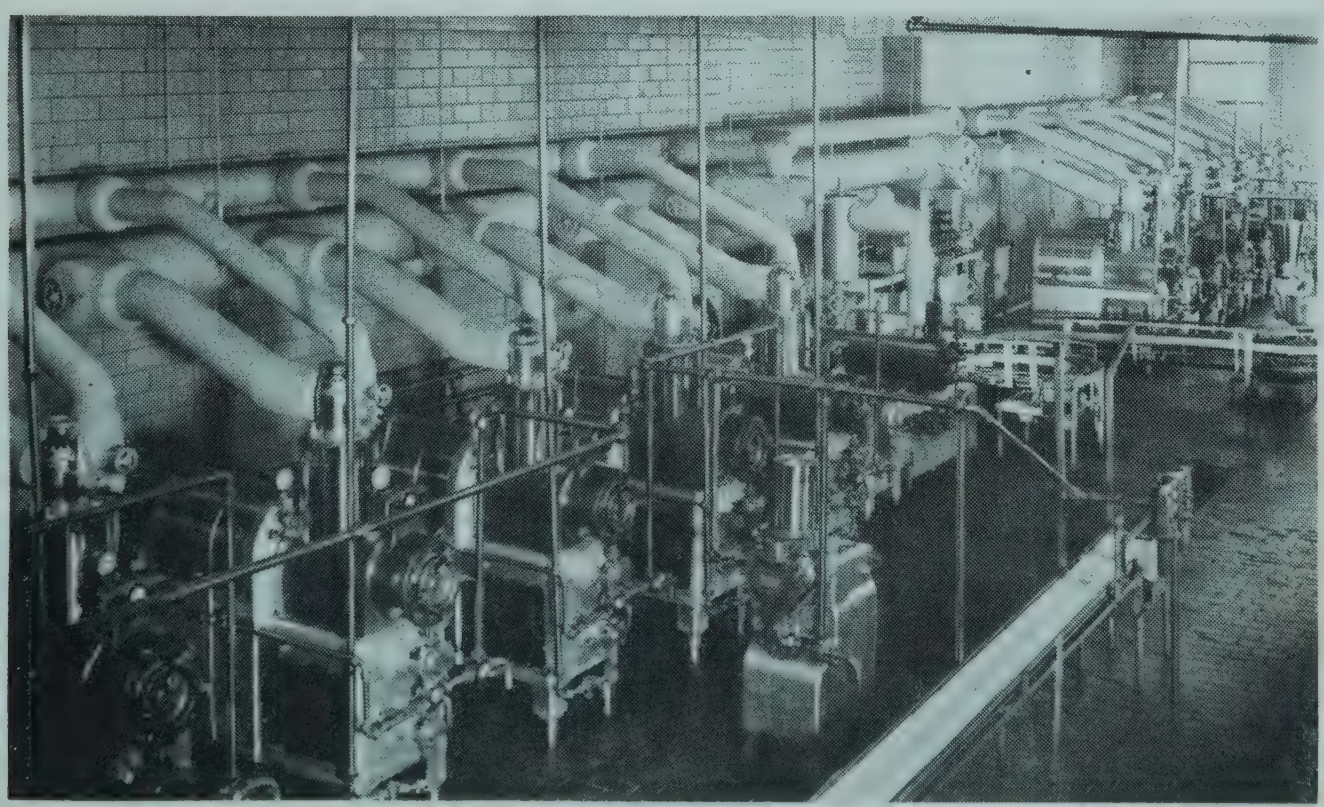
TABLE 18. HIGHER SUCTION PRESSURES MAY BE USED WITH A DIRECT EXPANSION FREEZER

Suction Pressure with Direct Expansion	Suction Pressure with Brine	Refrigerant Temp. on Freezer
3.6 lb.	0.0 lb.	–20° F.
6.2 lb.	2.0 lb.	–15° F.
12.2 lb.	6.2 lb.	– 5° F.
15.7 lb.	9.0 lb.	0° F.

A direct saving in equipment cost and repairs results when the brine, brine tank, brine pumps, *etc.,* are eliminated, as well as when smaller compressors are used.

THE FREEZING PROCEDURE

The first step in the freezing procedure is to prepare the freezer. Its parts should be inspected to be sure they are clean and dry, and then assembled



Courtesy, Creamery Package Mfg. Co.

Fig. 19. Modern large scale operation

[a] Lambert—Proc. 27th Ann. Conv. of Assoc. of Ice Cream Mfrs., Pa. and N. J., Nov. 1932, p. 33.

in accordance with instructions from the manufacturer. The operator's hands should be clean to avoid contamination of the product which later contacts these parts. When the freezer is assembled, some operators sanitize the machine by running hot water or a cold solution of a chemical sanitizing agent through the machine. In addition to sanitizing, this may also serve to test for leaks and faulty operating condition. While sanitizing, do not turn the dasher more than a few revolutions thus avoiding excessive wear. If hot water is used, it must be at least 180° F. to obtain any sanitizing effect, and must be followed by a cold water rinse to cool the freezer. When a chemical sanitizing agent is used, complete draining is essential.

The second step in the freezing procedure is adding the mix. When the freezer has been properly prepared, it is ready for the measured amount of mix, flavoring, and coloring. It is always desirable to have the temperature of the mix below 40° F. when it goes into the freezer. Color and flavorings should be accurately measured, and poured into the mix rather than carelessly poured on the sides of the vat or freezer. Uniform drainage of the measuring cups is essential to accurate measurement. The total volume of the mix, flavor, and color should be about half the total capacity of the freezing chamber; for a 40-qt. batch freezer the volume of the mixture would be about 20 quarts. Thus in vanilla and similar ice creams flavored with a pint or less of extract and color, it is customary to use 20 quarts of mix in a 40-qt. freezer; while in fruit or nut ice creams 18 quarts of mix with about 2 quarts of fruit or nuts make up the 20 quarts of mixture for a batch.

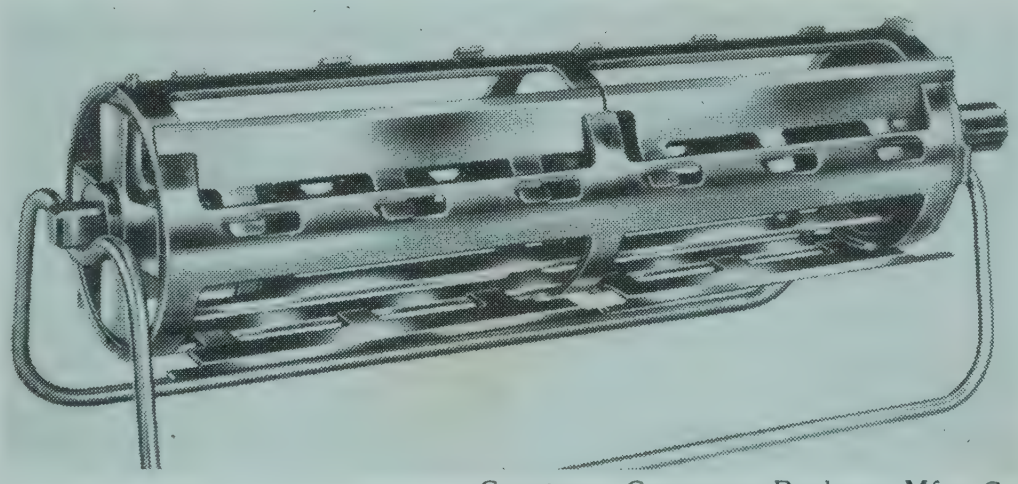
The flavoring and coloring materials must be added so as to become uniformly distributed, but the actual moment or order of adding them may be varied. Special precautions apply when adding acid fruits, nuts, *etc.*; these should be added only after some ice crystals have formed. Acid fruits will coagulate the milk in the mix if they are added before the ice crystals start to form. Nuts, candy, and cookies will be less likely to dissolve if added late, and fruits will remain in larger pieces. Therefore, such materials should be added as late as possible and still give time enough to have them uniformly distributed; it is best to determine the exact time for each machine, since some machines are more efficient in carrying the nuts back into the freezer, but generally it is safe to accept the manufacturer's directions as a basis. When using a continuous freezer, the solid materials (nuts, fruit, *etc.*) must be added as the ice cream is being discharged from the freezing chamber and all liquid material including fruit juices must be added to the mix before it passes into the freezing chamber.

Finally, the freezer should be operated uniformly as to speed, refrigerant, temperature, *etc.* The refrigerant temperature should be well below 0° F.

The mix is run into the freezer, the dasher started, and then the refrigerant is turned onto the freezing chamber. This sequence must be preserved to avoid damage to the machine. To avoid rapid dulling and wearing of the scraper blades, the dasher must never be operated when there is no mix in the freezer. The refrigerant must never be turned on unless the dasher is in motion because even a drop of water may freeze the dasher to the wall of the freezer and cause the dasher to be bent or twisted when attempting to start the machine. This order of operation and these precautions apply to all freezers regardless of size, type, or installation.

OPERATING THE CONTINUOUS FREEZER

Use of continuous freezer. In the continuous or instant freezers the mix is continually pumped into the machine and the frozen product is continually discharged from the machine. The operator's principal work is (1) to regulate the amount of air being introduced into the mix to give the desired overrun, and (2) to regulate the temperature of the refrigerant on the freezing chamber. Once the machine is started, the refrigerant is shut off from the freezing chamber only when the machine is to be stopped. Usually the refrigerant is shut off a few minutes before the last mix enters the machine,



Courtesy, Creamery Package Mfg. Co.

Fig. 20. CP Continuous Freezer Dasher. The action of this dasher is two-fold, first it provides a means of mounting and rotating the freezer blades so that the inner wall of the freezing cylinder is properly scraped clean of frozen ice cream and secondly, provides a means of whipping air into the finished ice cream so that the desired overrun and texture can be obtained. The thin film of ice cream mix that freezes on the cylinder wall must be constantly and completely removed by the freezer blades, otherwise the insulating effect of the built-up mix film will reduce the heat transfer of the cylinder by as much as 50%. Proper maintenance of freezer blades can contribute more to freezer performance than any other single factor.

so that the rinse water (100° F.) which follows the mix will pass through the freezing chamber without being frozen. The temperature of the refrigerant on the freezing chamber is adjusted to give the desired consistency when the product leaves the machine. While these two variables require frequent checks, changes in adjustments are not frequent and thus a large

quantity of ice cream can be made with comparatively slight variations in quality.

OPERATING THE BATCH FREEZER

The use of "batch" freezers makes it difficult to prevent undesirable variations and burdens the operator with many more details to get uniform quality. Each batch of mix must be measured, colored, and flavored separately, requiring the measurement of smaller quantities which presents many more chances for errors with resulting lack of uniform quality of finished ice cream. A carefully prepared work-plan will avoid many errors such as forgetting to add color, *etc.*

Using the sequence previously described, the machine is started, and then the operator must determine largely by observation, through the peep-hole, the correct time to shut off the refrigerant. At this correct time, only a small part of the water in the mix is frozen giving it a certain lustre and consistency which he must learn to recognize.

Shutting off the refrigerant too soon results in (1) longer time to obtain overrun, (2) possible failure to obtain the desired overrun as the softer condition will repel overrun, (3) too high temperature when drawn from the freezer, (4) soft ice cream, and (5) a tendency for coarse ice cream since the ice crystals formed slowly in the hardening room will be larger. **When the refrigerant is not shut off soon enough,** the mixture is too hard and results in (1) difficulty in obtaining overrun, (2) longer time in the freezer, as stiff ice cream repels whipping (even if it is allowed to soften in an effort to incorporate air), (3) usually a lower temperature when drawn from the freezer, and (4) a smoother ice cream provided it does not become soft in obtaining overrun.

After the refrigerant is shut off, the machine within certain limits continues to operate, incorporating air and freezing more of the mixture until the product attains both the desired overrun and the desired consistency. Then the operator allows the product to be drawn from the freezer. Since the air is incorporated during the freezing process and by the whipping action of the dasher, **the operator must adjust the refrigerant** to allow the right amount of time for whipping. This time will vary with the composition of the mix, the construction of the freezer, the rate of cooling or freezing, and the consistency, temperature, *etc.*, in the freezer. These latter conditions change so rapidly in the freezer that they can only be estimated by the operator's observation and this requires study as well as considerable experience. While there is some loss of air, in general it can be said, that up to a certain point air is being continually whipped into the ice cream mix. However, after that point is reached it loses air faster than it gains it, if the

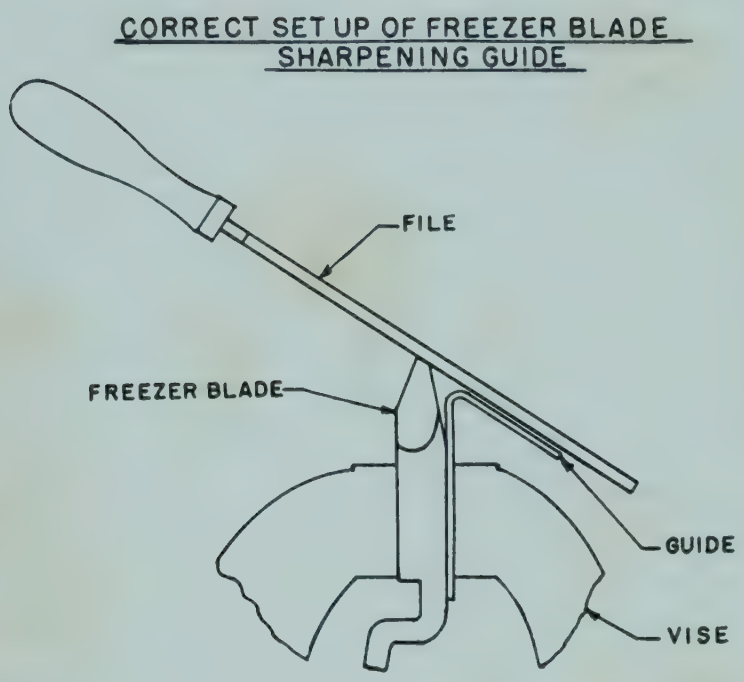
whipping is carried on too long. Therefore the operator must adjust the refrigerant so that the ice cream can be drawn at the moment when he has obtained the desired overrun and the desired consistency of the ice cream. When the ice cream is drawn from the freezer it should be stiff enough to "ribbon" or almost hold its shape, and yet soft enough to "settle" or lose its shape within a minute or two.

Filling the containers. The container or package into which the ice cream is drawn should be cooled sufficiently to prevent melting the ice cream. When such melting around the edges does occur, it will be frozen again later in the hardening room and the ice crystals formed will be large giving a coarse and icy condition at the edge of the package. Furthermore, this melting will cause a loss of overrun. Another precaution to take is against the formation of air-pockets which leave the container partly filled. This can be avoided easily if the ice cream is not too stiff when drawn. Precaution should also be taken to see that chocolate ice cream, acid-fruit flavored ice cream, sherbets and ices are placed either in well-tinned containers or more safely in paper or paper-lined containers, since the acid in these products will react with the iron to cause undesirable defects.

The freezer should be emptied as rapidly as possible to prevent wide fluctuations in overrun in the packages. Therefore, avoid filling small packages directly from the batch freezer. When a 40-qt. freezer is emptied into 2½-gallon containers, the first one may have 90 per cent overrun, the second 100 per cent, the third 80 per cent, and the fourth 70 per cent overrun. The variation will follow this general up and down trend, the extent of variation depending on the length of time required for filling each container.

When the containers are filled it is usually desirable to put a parchment paper over the top under the cover. This paper protects from the metal cover and may also be used to designate the flavor of the ice cream, date made, and possibly a key number to identify the operator, the batch of mix and freezer batch—information which aids in handling inventories, records, and tracing the cause of defects.

While the ice cream is being drawn from the freezer it gradually becomes softer and should not be "drained" out when it gets too soft. A possible exception to this rule is to drain the freezer completely when the freezer is to be taken apart and cleaned. At other times the small amount left in the freezer goes into the next batch, which can follow immediately without stopping the dasher. However, if the next batch is of a different flavor or color, *i.e.*, one which will not cover up or blend with the previous batch, it is necessary to take out the dasher and clean the freezer. This is especially true of nut and fruit ice creams, since pieces of nuts and fruit

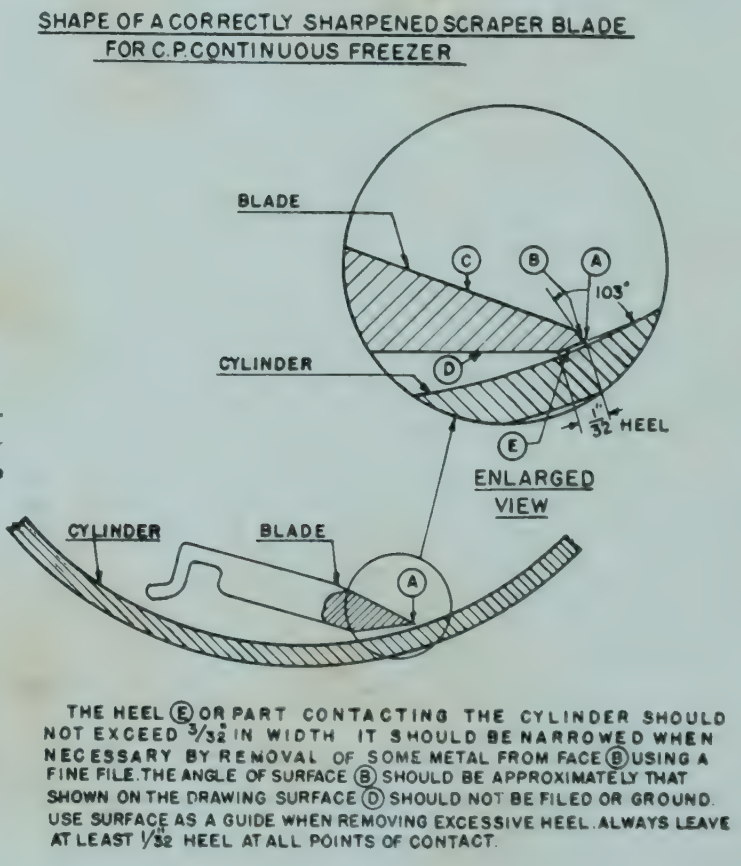


Courtesy, Creamery Package Mfg. Co.
Fig. 21. Correct Set-up of Freezer Blade Sharpening Guide.

cannot be removed from the dasher without taking the freezer apart, but if left in the freezer they will appear in the next batch of ice cream.

CLEANING THE FREEZER

When the freezer is not going to be used for two hours or more, it should be taken apart, cleaned, and sanitized. This is most easily and efficiently



Courtesy, Creamery Package Mfg. Co.
Fig. 22. Shape of a correctly sharpened Scraper Blade for CP Continuous Freezer.

done immediately after the last ice cream is drawn. The rinse water should not be over 100° F. to rinse out the ice cream, and the dasher during this process should be turned only a few revolutions. The dasher and other re-

movable parts should be removed to a sink and thoroughly scrubbed with a hot (120° F.) washing solution, rinsed, sanitized, and stored where they may dry. The freezing chamber and other parts which cannot be placed in a sink must be scrubbed with a hotter (130° F.) washing solution using special care to remove the greasy film left on the surface and in the corners (all places difficult to reach) especially at the rear of the chamber. These parts should also be thoroughly rinsed and left open to dry. The freezer should not be assembled until it is to be used.

HOW TO OBTAIN AND CONTROL OVERRUN

Overrun is usually defined as the volume of ice cream obtained in excess of the volume of the mix. It is usually expressed as "per cent overrun." This increased volume is composed mainly of air incorporated during the freezing process. The amount of air which should be incorporated depends upon the composition of the mix and the way it is processed, and is regulated so as to give that per cent overrun or yield which will give the proper body, texture, and palatability necessary to good quality ice cream. Too much air will produce a snowy, fluffy, unpalatable ice cream; too little air, a soggy, heavy product. Generally, mixes which have a high total solids content justify the incorporation of a higher per cent air—a higher overrun—than mixes lower in total solids. Although no definite per cent can be stated, some authorities indicate as most desirable a per cent overrun between two and three times the per cent total solids content of the mix. For example: a mix with a total solids content of 40 per cent might justify an overrun of as high as 100 per cent. Formulas for determining the overrun and solving problems in overrun are discussed elsewhere.

Five factors which are usually considered when **determining the amount of overrun** are:

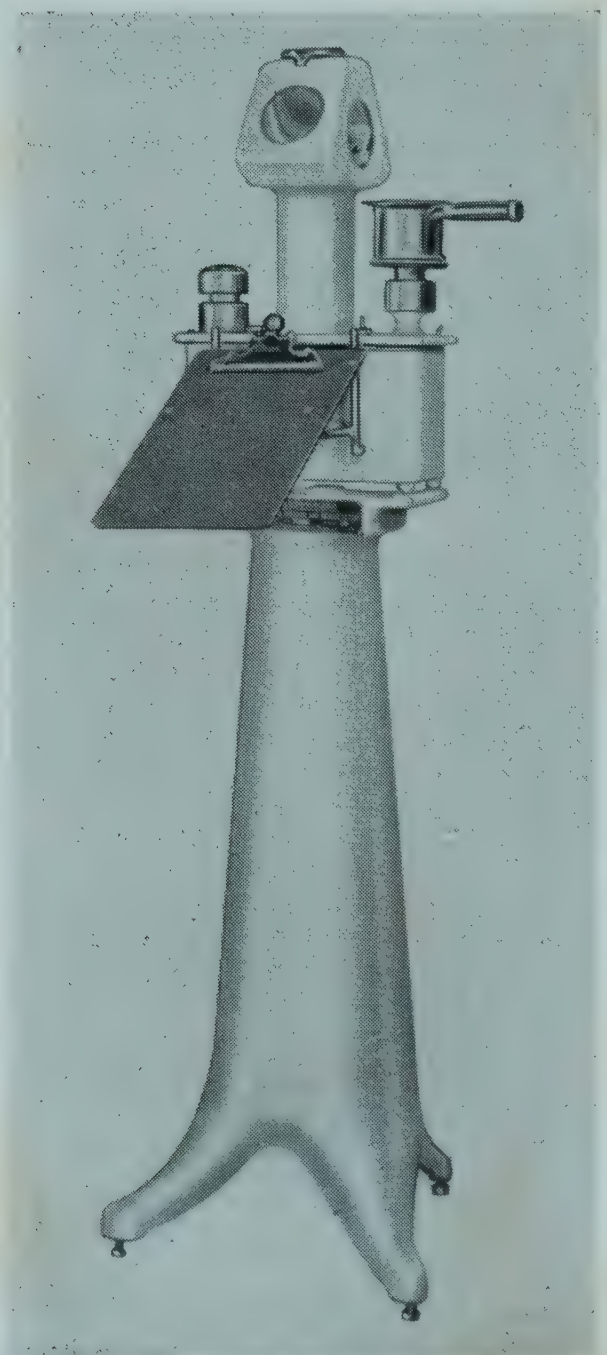
1. Legal regulations enforced in the market area.
2. Total solids content of the ice cream. Higher total solids may permit use of a higher overrun.
3. Composite ice creams (such as fruit and nut) require a lower overrun than plain ice cream in order to obtain an equally desirable body and texture. The correct overrun to take may be estimated as described in Chapter X.
4. Selling price of ice cream.
5. Type of package. So-called "bulk" packages which are sold for "dipping" usually contain 90 to 100 per cent overrun, while packages of the carry-home type (not dipped before reaching the consumer) usually are most satisfactory if they contain 70 to 80 per cent overrun.

The ability to obtain overrun at the freezer depends partly on the concentration and type of ingredients in the mix (see previous discussion on

influence of sugars, neutralizers, total solids, *etc.*) and on the freezing process itself. Sharpness of scraper blades, speed of dasher, volume of refrigerant passing over freezing chamber, and temperature of refrigerant are important, as described previously, to produce rapid freezing and favor overrun. The stiffness of the product at the time refrigerant is shut off and the fullness of the freezer are two of the most important factors and perhaps the two most likely to fluctuate under careless operation.

To secure uniform overrun and yield, the following points should receive consideration:

1. Uniformity in refrigerant temperature and rate of flow of refrigerant.
2. Use of overrun testers, Draw-Rite, or Willman controls.
3. Uniform make, *etc.*, of freezers for the freezer man.



Courtesy, Mojonnier Bros.

Fig. 23. Overrun Tester. Apparatus for quickly determining per cent of overrun in Ice Cream.

4. Not too many freezers per man.
5. Hopper systems for filling containers if batch freezers are used. This allows freezers to be emptied rapidly into a hopper where there is less agitation while filling packages. Higher overrun at the freezer is necessary to compensate for some loss in overrun in the hopper.

The control of overrun is very important and should be maintained as nearly constant as possible from batch to batch and from day to day. A variation of 10 per cent in overrun represents a sizable difference in profit to the manufacturer. Lack of uniformity is also frowned upon by the retailer and the consumer. The experienced, intelligent operator, with the aid of an overrun tester or laboratory checks, should not have much trouble with the control of overrun.

CHAPTER XIII

PACKAGING, HARDENING, AND SHIPPING

PACKAGING

When the ice cream is drawn from the freezer it usually is collected in containers which give it the desired shape and size for convenient handling during the hardening and marketing processes. These containers are of two types: the **single-service package** commonly made of paper, and the **multi-service package.**

The multi-service package. Originally, heavily tinned steel cans were used, and even now these are practically the only type of multi-service package in use. They are cleaned, sanitized, and used repeatedly. This type of package has certain **advantages,** such as:

1. There is greater ease in dipping out the ice cream from these heavy, rigid cans than from the more flexible paper containers.
2. These cans are not easily damaged even when packed in ice and salt.
3. They are less expensive, particularly if abuse and loss of the cans are prevented. Normally these cans average about 27 trips per year and by retinning them every two years will last ordinarily about six years. Where conditions favor more trips and longer life of the cans (especially without retinning) the cost may be greatly reduced.
4. There is less danger of the ice cream shrinking during hardening and marketing.

The most noticeable **disadvantages** of the multi-service package are:

1. The temptation to use cans that are not properly tinned and therefore may damage the quality of the ice cream, particularly chocolate.
2. The added expense of paper linings for metal cans when they are to be used for certain flavors of ice cream.
3. The temptation of the trade and the consumer to use the cans for purposes other than ice cream containers.
4. The difficulty in properly cleaning the cans due to inadequate equipment or personnel.
5. The danger of contamination during storage or handling after sanitization and before filling with ice cream.

The single-service type of package has met with increasing favor, especially during recent years. The rapid improvement of roads, delivery trucks, and mechanically refrigerated cabinets, as well as the wide use of continuous freezers and automatic packaging machines, have hastened the increasing

use of single-service containers. Also, the consumer's demands and purchasing habits have encouraged a definite change in favor of this type of package. In general, these packages are constructed of paper or cardboard which has been treated to make it impervious to moisture. The larger sizes have the minimum of very light-weight metal necessary to give correct shape to the package. As yet their use in special molds has been restricted to the simplest forms, such as replacing the metal 8-qt. brick pan or slab.

Some **advantages** of the single-service type of package are:

1. Less space required for storing a given volume of ice cream.
2. Less time required to harden a given volume of ice cream in the hardening room.
3. Elimination of the time, labor, and materials used to salvage, recondition, and properly clean the container, not only for regular customers but especially for the occasional orders like picnic gatherings.
4. Less rapid deterioration of delivery trucks and dispensing cabinets, because these cans are lighter in weight and have no sharp edges.
5. Less wear and tear on shipping bags.
6. Usually neater and cleaner in appearance.
7. Less danger of injuring the flavor of the ice cream.

Some **disadvantages** of the single-service type of package are:

1. The initial cost is high and cannot always be matched by the savings indicated under advantages.
2. When made of poorly processed paper, they increase the tendency towards the defect known as shrinkage.
3. They foster the habit of discarding property in contrast to the habit of thrift which endeavors to obtain the maximum usefulness of property.
4. They may be uneconomical even under conditions of mass production and high-cost, low-skilled labor.

The bulk package, so-called, has always been used in selling the hardened ice cream to retailers who repackaged it by dipping it into servings such as cones or into small containers generally of a quart or less. Either single-service or multi-service containers may be used for bulk packages. When metal containers were widely used, these bulk packages included sizes of one, two, three, and five gallons. During recent years, along with the advent of the single-service type of package, there has been a tendency to standardize on bulk packages of only the two-and-a-half gallon and five-gallon capacity, the one-gallon size being listed among the "carry-out" packages. The bulk packages are always factory-filled, usually directly from the freezer (freezer-filled) or sometimes from a hopper which collects the ice cream from the freezer. The hopper is insulated or refrigerated and is

generally installed so that a number of batch freezers can be emptied into it without interrupting the freezer-emptying process, and so that the ice cream can flow by gravity to a lower level where it is packaged. The advantages and disadvantages of hopper systems are about the same as those for package-filling machines. The necessity for speed in emptying the batch freezer (in order to avoid variations in overrun) makes it undesirable to freezer-fill packages of less than two-and-a-half gallon capacity. When filling bulk packages many manufacturers use ice cream having 90 to 100 per cent overrun, which is slightly higher than for ice cream placed in "carry-out" packages.

The "carry-out" or "take-home" package represents the most important development in the packaging of ice cream. This change has paralleled the adoption of the continuous freezer, the automatic packaging machine, and the development of the single-service type of package, as well as the emphasis by the consumer on the "ready packaging of all food products." The carry-out package for ice cream has practically always been the single-service type and made of paper or cardboard in sizes of one quart or less. When packages of such sizes are filled directly from the batch freezer, consecutive packages will contain ice cream having widely different overruns. A possible exception to this is the brick ice cream that is molded in 8-qt. slabs and then cut into individual bricks which are wrapped and cartoned by hand.

PACKAGING MACHINES

Packaging Machines or Fillers are used to fill the small carry-out packages. These machines are either insulated or refrigerated and are so constructed that contents of the freezer can be emptied into them quickly. There is only gentle agitation of the ice cream in these machines, which prevents wide variation of overrun in the packages. The major **disadvantages** of fillers are:

1. The ice cream has to be too soft to give an ideal smoothness of texture in the finished product.
2. Some overrun (3 to 10 per cent) is necessarily lost, and the loss is not easily controlled.
3. It is difficult to maintain the temperature of the ice cream so as to avoid either partial melting or continued freezing.

However, these machines are still the most economical and satisfactory method of factory-filling packages containing less than one pint regardless of the type of freezer being used. The continuous freezer has already made it possible to economically and satisfactorily fill packages containing one pint or more directly from the freezer, and new equipment now in use in several ice cream plants seems to indicate that eventually much ice cream will be pre-packed in individual serving-sized portions.

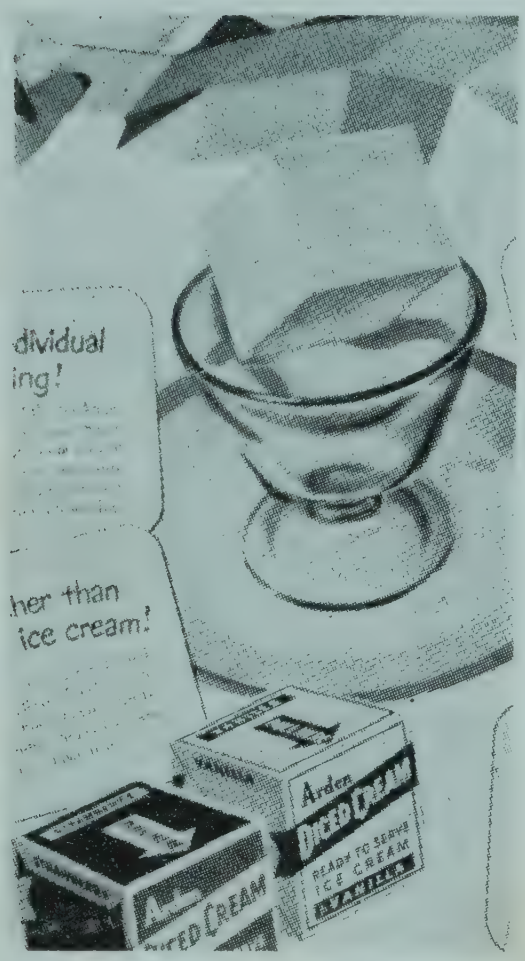


Fig. 24. Shows individual serving-sized portion machine-packaged, and also ready to serve. Originator says it saves labor, eliminates dipping and shrinkage.

Some **advantages of the factory-filled** carry-out package are:

1. Greater convenience in handling.
2. Retailing at much lower temperature, thus reaching consumer in better condition.
3. Less danger of the retailer damaging the quality of the product.
4. Less chance of bacteriological contamination, especially during retailing.
5. Less variation in quantity as well as quality from one package to another.
6. Faster and more convenient serving of customers.
7. Less difficulty in estimating profits and keeping records.
8. Neater appearance of package.

The ice cream put into the factory-filled carry-out package should usually have a lower overrun than the same product put into bulk packages. This should encourage the consumer to switch to factory-filled packages. The difference in overrun is commonly from 15 to 20 per cent and partially compensates for the greater weight obtained when the retailer "dips" a similar package from the retail cabinet.

The dipped package usually refers to carry-out packages filled by the retailer who dips the hardened ice cream from a bulk package in his cabinet and presses it into the new container. The advantages of this practice are completely outweighed by such **disadvantages** as:

1. The greater chance for unintentional contamination by the retailer.

2. The wide variation in the amount of ice cream placed in containers of equal size. The main factors influencing this variation are:

a. Temperatures of ice cream (3° to 8° F. is generally recommended to make dipping easy but it varies with freezing point, *etc.*, of the ice cream.)

b. Individuality. Variation from person to person doing the dipping is great.

c. Composition and air content of the ice cream.

3. The inevitable delay in serving customers.

4. The necessarily higher temperature of the ice cream when it leaves the retail store. It has to be softer for dipping and therefore does not reach the home in as good condition.

5. The damaged quality, especially in body and texture of the ice cream.

6. The inability of the retailer to control operating costs. Since it is impossible for the retailer to completely fill equal-sized containers with equal weights of dipped ice cream, it is impossible for him to operate on a narrow margin or to estimate his profits.

A similar practice of dipped packaging is employed when making fancy molds; *i.e.*, fancy shapes resembling animals, flowers, *etc.*

Metal molds are filled with ice cream dipped from bulk packages because the molds do not hold enough ice cream to be filled from the freezer. Most of the disadvantages listed above are equally applicable here. An additional disadvantage, in this case, lies in the fact that using too much pressure, in order to force the ice cream into the corners of the mold, will pack the ice cream so solidly that it must be melted before it can be cut with a spoon for eating. Such hard ice cream is especially undesirable in "center-molds."

THE HARDENING PROCESS

When ice cream is drawn from the freezer and put into the container to be placed in the hardening room it has a semi-fluid consistency not stiff enough to hold its shape. Therefore the freezing process is continued without agitation until the temperature of the ice cream reaches 0° F. or lower. Here, as in the freezer, it is desirable to get quick freezing or quick hardening, since slow hardening favors large ice crystals and coarseness.

The time required for hardening has been assumed to be the time necessary for the temperature at the center of the package to drop to 0° F. This hardening time may be as short as 30 minutes for quarter-pint packages or as long as 24 hours for five-gallon packages, and the shorter time always gives a smoother ice cream. A hardening time of 6 to 8 hours for five-gallon pack-

ages is usually considered excellent operation, but most operators allow at least 12 hours.

Factors affecting the hardening time. Some of the more important of these factors are:

1. Size and shape of package. Doubling the size of the package increases the hardening time by about 50 per cent; when 2½-gallon packages require 14 hours, the 5 gallon packages will require about 22 hours. The shape is important in determining the amount of surface area per gallon of ice cream and also the speed of air-flow around the package. Light-colored packages and those having good reflecting surfaces are slower to cool.

2. Air-circulation. With forced circulation like an air blast, hardening requires only about 60 per cent of the time required in still air. Of course the speed of the air blast is also important. This emphasizes the need of properly stacking the packages to facilitate rapid air movement, and also suggests the desirability of hardening each package rather than making bundles of packages.

3. Temperature of the air. Temperatures above -10° F. and colder than -25°F. are less desirable from the standpoint of quality of product and economical operation.

4. Section of the room. In the "still air" type of room the ice cream hardens about as quickly near the ceiling as on the floor, while directly on the ammonia coils it requires only two-thirds as much time. The center aisle requires twice as long.

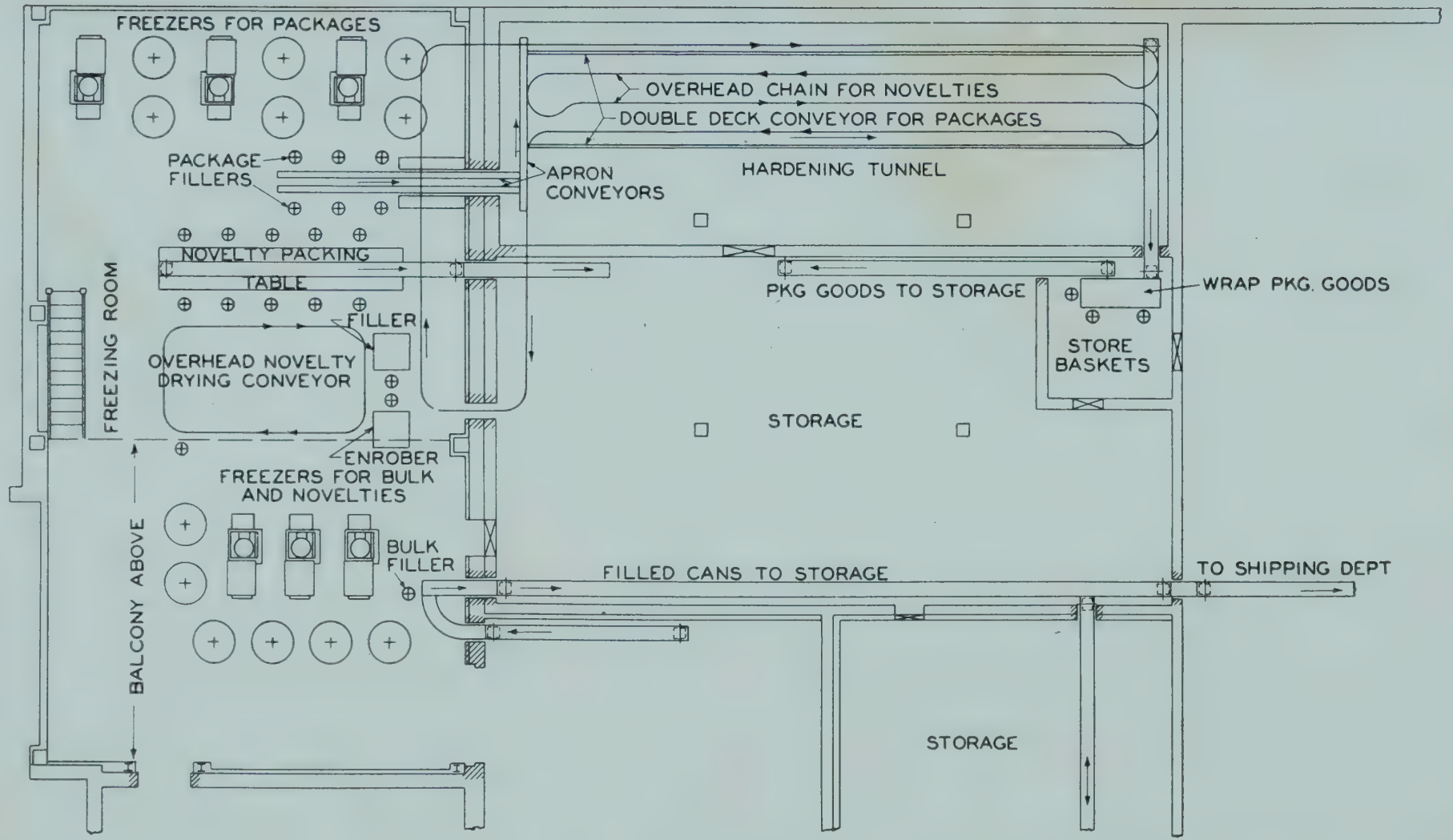
5. Temperature of ice cream drawn from the freezer. Drawing the ice cream at one degree higher temperature will increase the hardening time by about 10 to 15 per cent.

6. Composition of the mix. There is a tendency for shorter hardening time as the fat content decreases and as the freezing point of the mix rises.

7. Per cent overrun. There is a slight tendency for the hardening time to increase as the percentage overrun increases.

Hardening Rooms where the packaged ice cream is placed in dry air maintained at a temperature between -10° and -50° F. are used by modern manufacturers. Most factories employ ammonia as the refrigerant to maintain a temperature of -20° or -25° F. For economical operation, the hardening room should be entered through an ante-room which may be large enough to permit storage of some ingredients at about 30° F. The hardening rooms may be classified as follows according to the arrangement of the ammonia coils used for cooling.

1. Ceiling Coils. When the coils are located along the ceiling there may be a metal baffle plate immediately beneath them to facilitate air circulation



Courtesy, Alvey Conveyor Mfg. Company.

Fig. 25. Conveyor Equipment for Hardening Tunnel quick freezing.

The drawing shows a typical freezing plant for producing and finishing bulk and package ice cream novelties, either coated or uncoated.

In a plant of this general size there is conservatively estimated, a producing capacity for freezing as much as 450 gallons in pint cartons per hour and 200 trays of frozen novelties, with facilities for enrobing if desired.

The preparation of the mix is usually accomplished in another location in the plant and the finished mix is delivered to the storage tanks in the freezing department for processing.

Conveyors progress the packages or novelties through the hardening tunnels and into the storage room and are also arranged to speed delivery to the shipping department.

by gravity. This type allows great freedom in the use of floor space for conveyors, arrangement of ice cream, *etc.* The major **disadvantages** are:

a. The lack of uniform temperature unless fans are used to aid air circulation.

b. The temptation to pile packages too close together, causing slow hardening.

c. Difficulties in taking inventories.

d. Difficulties in defrosting the ammonia coils.

2. Horizontal Shelf Coils. The most common arrangement of the ammonia coils is in horizontal shelves as well as along the ceiling. These are the so-called "still air" type and seldom gain much efficiency by the use of fans. The major **disadvantages** of this type are:

a. Much valuable space is made useless by the mass of coils.

b. The coil shelves interfere with the use of conveyors.

c. There are difficulties in defrosting the ammonia coils.

3. Vertical Coils. A third type of hardening room arranges the coils in a vertical position like a fence dividing the room into sections or bins. The main **disadvantages** of this type are:

a. The temptation to pile packages too closely.

b. Less convenient use of conveyors.

c. Difficulties in defrosting, although these coils are more easily kept in good condition than are those in the two previously mentioned types.

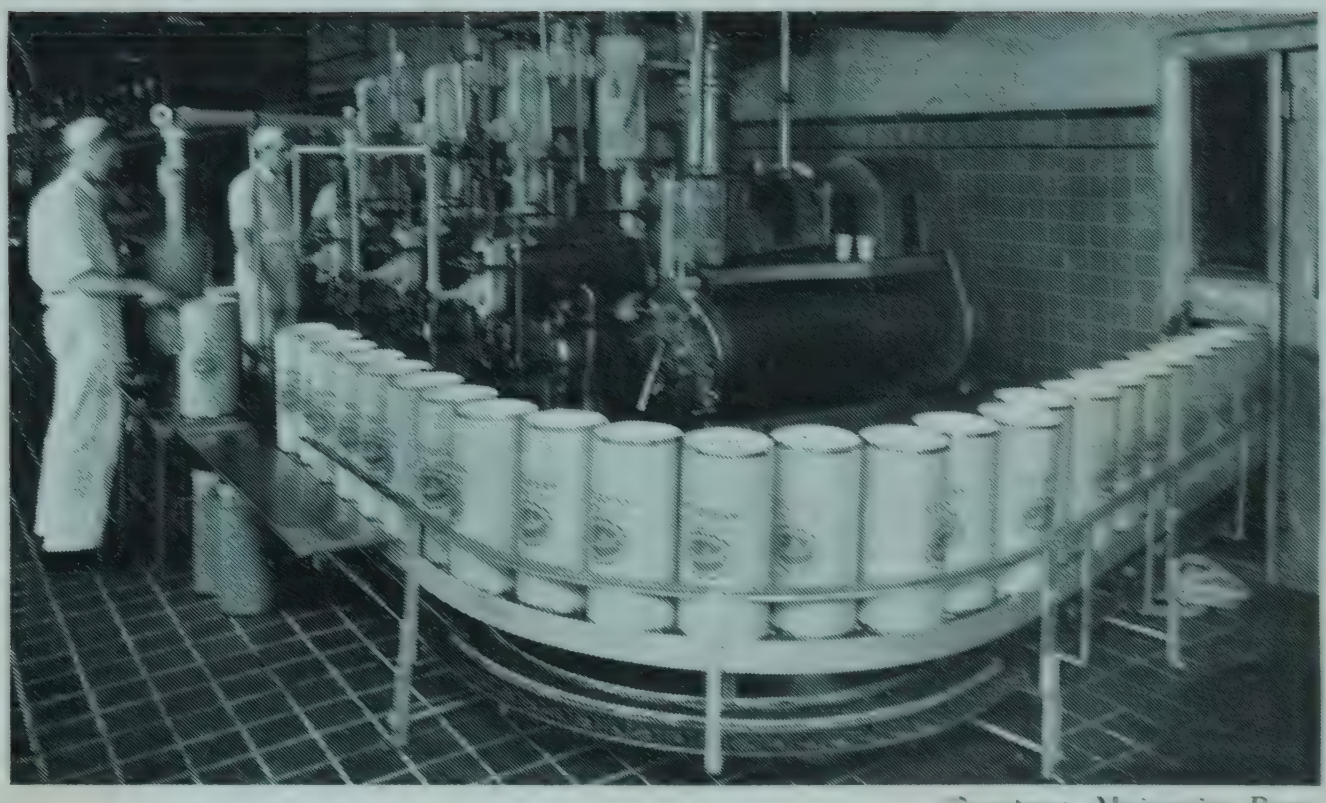
4. Forced Air Cabinet. A fourth type of hardening room is now approved and widely accepted by modern manufacturers. In this type the ammonia coils are arranged in a cabinet through which the air is circulated by fans. Air ducts with openings at various parts of the room aid in obtaining the rapid air movement necessary for uniform temperatures and rapid freezing. The cabinets containing the ammonia coils may be located outside of the hardening room—an aid to defrosting. The main **disadvantages** of this type are:

a. The temptation to pile packages too closely.

b. Difficulties in taking inventory.

Hardening Tunnels. Some manufacturers of larger volumes use hardening tunnels containing an air blast at -30° to -50° F. for fast hardening. These may or may not contain a conveyor belt, and have their greatest advantages when hardening the smaller packages which can be hardened in an hour.

Hardening Cabinets resemble the retail ice cream cabinet, and are refrigerated either by brine or mechanical refrigeration. The ice cream package is placed in the dry, water-tight compartments, each of which will hold



Courtesy, Mojonnier Bros.

Fig. 26. Conveying Ice Cream cardboard cans on Mojonnier Conveyor in Hydrox Corp., Chicago. A labor and refrigeration saving device.

one or two five-gallon containers. These are usually operated at a temperature between -10° and -15° F., are most economical for a limited volume of business, and avoid exposure of the operator to sudden chilling temperatures.

Hardening with Ice and Salt. The hardening of ice cream may also be accomplished by packing a mixture of ice and salt around the container. This method is commonly used by small manufacturers. The salt should be coarse (crushed rock salt) and placed both in and on the upper third of the ice. The amount of salt used should be one-fifth of the weight of the ice (*i.e.*, 1 lb. of salt for every 5 lb. of ice); never more than one-fourth or less than one-sixth. With this method it is practically impossible to harden the ice cream to a temperature of 0° F., which means very slow hardening and consequently large ice crystals and a coarser texture. Also, the re-icing causes fluctuations in temperature which further damage the texture of the ice cream. Therefore, the method is economical for only special conditions, usually of small volume and low-cost labor.

Summing up, modern manufacturers place the packaged ice cream in a dry-air hardening room maintained at a temperature between -10° F. and -50° F. Small manufacturers now use the cabinet type which has individual water-tight compartments each of which will hold one or two five-gallon containers, and is refrigerated either by brine or mechanical refrigeration. These are usually operated at a temperature between -10° F. and -15° F.,

and most economical for limited volume of business, and avoid exposure of the operator to sudden chills.

Precautions to observe in the operation of hardening rooms:

1. Provide facilities for calling aid should operator accidentally be trapped inside the hardening room. Sometimes the latch on the door fails to operate properly, making it impossible to open the door from the inside. At such times, a telephone or alarm system for calling for help is necessary and should be installed in such a manner as to attract help from outside when regular workers in the plant are absent.

2. Keep both an ax and a sledge hammer in a definite place just inside the door. These might be needed for breaking through the door as a last resort in case assistance cannot be obtained.

3. Keep wooden doors, *etc.*, well painted, since the moist wood tends to give off odors which are absorbed by unprotected ice cream.

4. Keep floors, walls, *etc.*, clean. Specialties decorated with whipped cream acquire off-flavors from odors in the air due to dirty floors, *etc.*

5. Do not store non-dairy products, wooden boxes, or crates in the hardening room.

6. Avoid placing ice cream packages close together until hardened.

7. Avoid placing newly frozen ice cream close to packages that are already hardened.

8. Have the packages plainly dated and remove the older packages first.

9. Avoid fluctuations in temperature.

10. Remove frost from the ammonia coils frequently. Frost ¼ inch thick or more greatly decreases the efficiency of the coils. For methods of defrosting see page 219.

11. Whenever feasible avoid keeping the same ice cream in the hardening room for more than five days.

12. Take inventory at regular intervals, preferably daily.

STORAGE

After the ice cream is hardened it may be immediately marketed, or it may be stored for a week or two at the most. Manufacturers plan on a maximum of five days between freezing and marketing, with an average of a 3-day turnover. At least 12 hours of this time is required for hardening the ice cream which frequently remains in the hardening room until marketed, thus using the same room for both hardening and storage. Since the hardened ice cream can be stored satisfactorily at slightly higher temperatures than are required for hardening, it is sometimes more economical to use

special storage rooms. This is particularly true of retailers who may use one cabinet for storage in addition to the dispensing cabinets.

The operation of storage rooms is the same as for hardening rooms with two exceptions:

1. The temperature should be maintained uniformly at a point between -10° and 0° F.

2. The packages should be piled very closely to delay changes in the temperature of the ice cream.

SHIPPING

When the ice cream is marketed, the manufacturer usually ships it to the retailer under refrigeration at the same temperature as is maintained in the retailer's cabinets. Today there are many methods of accomplishing this, none of which have been accepted as standard. The applicability of any method depends upon many conditions, and these conditions are not readily standardized; therefore no definite recommendations are made.

Insulated packers with no refrigeration are commonly used for short distances (a maximum of 6 to 8 hours) where the packer remains closed during the entire time. Double-walled insulated canvas containers are the most common. **Precautions** to observe in their use are:

1. Thoroughly chill in the hardening room (about 4 hours) before loading them with ice cream. This requires extra space in the hardening room.

2. Avoid getting them dirty since they cannot be easily cleaned to make attractive package so necessary and desirable for a food product.

3. Avoid getting them water-logged. Insulation loses most of its efficiency when wet.

4. Keep them closed tightly. Any air vent reduces the efficiency of the insulation.

Refrigerated shipping methods can best be discussed in four groups or types of refrigeration.

1. **The ice and salt pack** was the original type. A water-tight container of ice cream was placed in a larger tub and completely surrounded with a mixture of 1 lb. of salt to 6 lb. of ice, then covered with a canvas cap. The outer tub or packer should not leak, since the accumulating brine is a valuable refrigerant. The obvious **disadvantages** are:

   a. The extra weight to be handled.

   b. The extra labor.

   c. Extra cost of ice, salt, and transportation.

   d. Rapid deterioration of packer tubs, ice cream containers, *etc.*, due to the severe action of the brine.

2. **Brine disks or cartridges** have been widely used as refrigeration in shipping. These metal containers or cartridges of various size and shape are filled with calcium chloride brine (or, in some cases, an ordinary salt solution), and permanently sealed. The shape and size are determined by the type of packer they are to fit. These cartridges are completely frozen in the hardening room which requires a temperature of at least –10° F. They are used around or on top of the package of ice cream, inside of insulated packers which are either of rigid construction or of the double-walled canvas type. These brine disks have the following **advantages:**

a. More convenient to handle.

b. Lighter in weight than ice and salt for a given amount of refrigeration.

c. Less messy than ice and salt.

d. No brine damage to ice cream containers.

e. Fairly inexpensive in the long run.

The main **disadvantages** are:

a. Providing hardening room space for freezing them.

b. Failing to completely freeze them due to hardening room temperature being above —10° F., or to allowing insufficient time.

c. Ease of losing them

d. Damaging them so that they leak.

3. **Dry Ice.** The third and most recent type of refrigeration uses carbon dioxide ice, more commonly known as "dry ice." This ice is sawed into pieces of appropriate size, which are wrapped in paper to delay the rapid melting, and then placed around the package of the ice cream inside an insulated packer, or in the single-service type packer. The latter are usually cardboard boxes insulated with corrugated cardboard and are used especially for the carry-out packages. There are several distinct **advantages** of this type of refrigeration:

a. Free from moisture and messiness.

b. Requires no salt.

c. Package is neat in appearance.

d. Does not water-log the insulation.

e. Is very light weight.

f. Is especially good for "specialties" sold direct to the consumer where no return trip to pick up packers is required.

The main **disadvantages** of dry ice are:

a. Present high cost and limited availability.

b. Loss during handling and storage, amounting to 10 to 15 per cent in many cases, due to the impracticability of providing sufficient insulation in storage boxes.

c. Danger of "burns" to handlers. The very low melting point makes it easy to freeze fingers without the sensation of cold, causing severe damage. Therefore care must be used by those who handle it.

d. Necessity for unpacking or removing the ice cream. The ice cream must be unpacked or removed from the dry ice sufficiently long to allow it to soften so as to be easily eaten and so that the delicate flavors may be properly appreciated.

e. The greater opportunity for "heat-shock." When ice cream warms up and then freezes harder again, it receives a "heat-shock" which may injure the texture. Dry ice freezes the ice cream to lower temperatures than do the usual hardening rooms.

4. **Mechanical refrigeration,** so-called, is the fourth type used. This type uses a complete refrigeration system with the expansion coils cooling the packer. These packers are similar to storage rooms, and are mainly truck bodies for trucking large volumes and for long hauls as much as 48 hours.

For many years special truck bodies have been used for moving large volumes and these truck bodies can be classified in the groups already described for packers. One variation of the brine disks, as applied to trucks, is a brine tank in the top of the truck. Ammonia coils are installed for freezing the brine in the tank and these coils are extended outside of the truck with the necessary fittings for conveniently connecting onto similar fittings on the refrigeration system in the garage at the factory. Thus the brine tank in the top of the truck is frozen while the truck is idle in the garage overnight and is ready for shipping in the morning.

The many problems and the variety of special conditions connected with shipping by truck have made it impossible to standardize the procedure or the truck, and especially difficult to get comparative cost data. For example, costs, efficiency, and depreciation are all influenced by such items as road conditions, the driver, frequency of opening the truck for partial unloading, *etc.* Therefore, definite limitations and advantages cannot be stated.

CHAPTER XIV

HIGH FAT AND HIGH SERUM SOLIDS ICE CREAMS

When ice cream is made and sold under the usual commercial conditions of large scale operation, it contains between 36 and 41 per cent total solids, and is acceptable to the largest group of consumers. Ice cream containing more than 41 per cent total solids is frequently called **high-solids** ice cream and seems to be preferred in certain limited or special markets. It contains a larger amount of the expensive milk fat solids than is found in the ordinary commercial ice cream. A noticeable characteristic is that it does not melt down to a smooth creamy liquid. The term high-solids ice cream also may be applied to ice cream which contains less than 41 per cent total solids, but has a greater concentration of serum solids than the maximum usually prescribed.

CHARACTERISTICS OF HIGH SERUM SOLIDS ICE CREAM

High serum solids ice cream has been made in the western part of the United States for a long time. It is made by using such specially prepared products as soluble casein and low-lactose skim milk powder. These ingredients increase the "chewiness" and the percentage of desirable milk proteins while at the same time avoiding the lactose concentration which so often causes sandiness. It is also one way of avoiding the high fat content or excessive richness. High serum solids ice cream always contains a higher concentration of serum solids than the maximum as stated on page 33, but may contain less than 41 per cent total solids provided the fat is less than 14 per cent and no corn syrup solids are used. When balancing a high serum solids ice cream mix, it is generally desirable to obtain part of the sufect from dextrose which will slightly lower the freezing point so that the ice cream can be more easily and efficiently dipped from cabinets maintained at the usual temperatures. It is also possible to lower the sufect concentration by as much as two points without sacrificing any sweetness of taste. At the same time the serum solids concentration may be raised as much as three or four points. These ice creams need slightly different processing procedures from those used for ordinary commercial ice cream. For example, the homogenizing pressures may need to be lower to avoid a curdy appearance in the melted ice cream; the capacity of the cooler may have to be increased due to the extra viscosity of the mix; and a higher overrun is advisable to avoid sogginess.

HIGH FAT ICE CREAM

High fat ice cream contains more than 16 per cent fat and more than 40 per cent total solids. Such ice cream, rich and smooth in texture, has been

a favorite particularly in New England where it is often featured and sold at the roadside stand or dairy stand. These stands are generally located along heavily traveled roads with ample parking space around the stand so that customers may be served in their cars. This ice cream usually contains 20 per cent fat or more, all ingredients are of high quality, and it is generally frozen on the premises.

High fat[a] ice creams present special problems because the influence of the fat on the properties of the ice cream is accentuated. The use of butter, plastic cream, or frozen cream tends to produce excessive viscosity which interferes with cooling the mix and obtaining the proper overrun. When these products are the only source of fat they should be emulsified in fresh, sweet skim milk or milk before the other ingredients are added. For this quality of ice cream usually only fresh cream and fresh milk are used to supply the milk solids. No additional sources, such as condensed milk, condensed skim milk, or skim milk powder, are used. Thus the resulting flavor is that of fresh cream entirely free from any serum-solids flavor—an important character of this type of ice cream.

Low serum solids content is important. The serum solids content of these ice creams must be low, decreasing as the fat content increases. For example, 7.5 per cent serum solids with 18 per cent fat, or 7.0 per cent serum solids with 20 per cent fat give good results. The low concentration of serum solids in relation to the fat content favors a crumbly body which is a common defect of high fat ice creams. This crumbly body may be avoided by using 16 to 17 per cent sucrose (depending somewhat on the fat content), or by using dextrose (not corn syrup solids) to supply about one-fourth of the total sufect. High-fat ice creams need a higher concentration of sufect than lower fat ice creams in order to please the majority of consumers. This higher concentration of sufect and especially the use of dextrose improves the melt down of the ice cream which frequently is very slow and curdy. The gelatin content must be about the same as for ice creams containing only 14 per cent fat if smoothness is to be secured because lower homogenization pressures are used and the temperature of the ice cream when drawn from the freezer is higher.

Problems in processing and freezing. High fat ice cream also presents problems in processing and freezing. *Homogenization* is considered essential to prevent partial churning in the freezer, especially in those freezers constructed to accomplish a drastic whipping action. However, relatively *low homogenization pressures* must be used, decreasing as the fat content is

[a] The late Professor M. J. Mack of the Mass. Exp. Sta. did much research on "high fat" ice creams, and the authors wish to credit him with much of the information given here regarding high fat ice cream

increased. When fresh cream and fresh milk are the only sources of milk solids, either single stage or double stage homogenization can give good results. The following range of pressures is recommended as a guide:

18 per cent fat mix		20 per cent fat mix
1500 lb. single stage	minimum	1000 lb. single stage
2000 lb. single or 1500 lb. - 500 lb. double	optimum	1500 lb. single stage or 1000 lb. - 500 lb. double
2500 lb. single stage	maximum	2000 lb. single stage

If three-stage homogenization is practiced, the fat may be obtained from such sources as butter, plastic cream, or frozen cream. The three-stage homogenization has been obtained by attaching a reducing valve to the discharge line of a two-stage homogenizer. Pressures of 2000, 500, and 150 lb. are suggested as satisfactory maximum pressures for the first, second, and third stages respectively, for homogenizing an 18 per cent fat mix. Slightly lower pressures of 1500, 500, and 150 lb. are suggested maximum pressures for homogenizing a mix containing 20 per cent fat. In addition to changing the homogenization pressure it is necessary to change the freezing procedure by raising the freezing temperature progressively with each increase in fat content. Drawing temperatures of 25.5° F. for 18 per cent fat and 25.8° F. for 20 per cent fat ice cream allows rapid whipping and ease of emptying the freezer, thus avoiding the excessive stiffness in the freezer which would decrease the rate of whipping and the ease of emptying the freezer. Finally, these high fat ice creams are slow to melt and often are excessively viscous, and therefore relatively high serving temperatures of 16° to 20° F. improve the flavor and the ease and efficiency of dipping.

CHAPTER XV

ICES AND SHERBETS

Ices are distinguished by having a tart or acid flavor and no milk solids. Other characteristics that differentiate them from fruit ice cream are (1) a much lower overrun, usually 25 to 30 per cent, (2) a more pronounced fruit flavor, (3) a coarser texture, (4) a higher sugar content, between 25 per cent and 35 per cent, which gives a lower melting point, (5) a greater cooling ability while being consumed due to their lower melting point, faster melting, and coarser texture, and (6) an apparent lack of richness due to their lower solids content.

While they constitute only a small part of the total gallonage in the ice cream factory, they are important as relishes, summer delicacies, and in combination with ice cream in fancy ice creams and specialties.

PREPARATION OF ICES

Base or Stock Mix. Ices are frequently made in hundred pound lots and manufacturers prepare a "base" or "stock" mix as follows:

21 to 25 lb. sucrose (cane or beet sugar)
7 to 9 lb. glucose, invert sugar, or corn sugar
0.4 to 0.6 lb. stabilizer
Water to make a total weight of 80 lb. of base or stock mix—balance of the 100 pounds being flavoring and additional water.

The amount of sucrose used should be the least that will give the desired sweetness in the finished ice, thus giving a higher melting point more suitable for dipping at the usual cabinet temperatures of 3° to 8° F.

The amount of glucose, invert sugar, or corn sugar should be about one-third of the amount of sucrose. This sugar reduces the tendency to form a surface crust which sometimes happens when sucrose is used alone. The use of Frodex, Sweetose, Karo or other source of corn syrup solids tends to keep the melting point nearer to that of ice cream, so that the product will have a firmness most suitable for dipping at the usual cabinet temperature.

Stabilizers are more important in ices than in ice cream because of the lower total solids content. In the selection of a stabilizer, consideration should be given to its effect on overrun, syrup drainage, and body (crumbliness) as well as its availability, convenience of use, and personal preference. Of the various stabilizers—cellulose gum, gum tragacanth, India gum, agar-agar, gelatin and pectin—the last two are most widely used. Best results are obtained by using a combination of two or more of these stabilizers, the ratio of combination depending on the grade and kind of stabilizers being com-

bined. Enough stabilizer should be used to cause a partial gelling at cold room temperatures.

Preparation of base mix. This base is prepared by slowly adding the dry ingredients to at least part of the water, using care to avoid lumpiness. Heating may be necessary to facilitate solution, especially when stabilizers like gelatin or agar-agar are used. Pasteurization is optional, but homogenization is not practiced. The prepared base is cooled before other ingredients are added. Aging is necessary only when gelatin or agar-agar is used in the stabilizer, and then an aging period of 12 to 24 hours is desirable.

This base mix is now ready for the flavor and color material. To each 80 lb. of the cooled base mix enough flavor, color, and water is added to make the total weight 100 lb.

The flavor and color mixture is made from the following ingredients:

1. Fruit juices. Although the amount varies with the intensity of the flavor, it should be from 15 to 20 per cent of the weight of the finished ice. Avoid having too many seeds.

2. Flavoring. Natural extracts and artificial flavors may not produce as desirable a flavor as the fruit juices, but they are often used to fortify the flavor and thereby produce a more uniform product.

3. Coloring. Approved artificial food coloring aids in maintaining a uniform shade of color characteristic for and suggestive of the flavor.

4. Citric acid solution. To obtain the desired tart flavor a fruit acid such as citric acid or tartaric acid may be added. When fruit acids are not available, either saccharic acid, phosphoric acid, or lactic acid may be used, but these do not impart an equally desirable flavor. It is a common practice to use a 50 per cent solution (*i.e.,* one lb. of crystals to one lb. of water) of either citric acid or tartaric acid. The amount of this solution generally used varies from 4 oz. to 10 oz., depending on the acidity of the fruit juice. The titratable acidity of the finished ice should not be less than 0.35 per cent nor more than 0.40 per cent when expressed as lactic acid.

5. Additional water may be necessary to make the total weight of this mixture up to 20 lb.

The freezing procedure in the making of ices is similar to that for ice cream. Many manufacturers prefer to use a special batch freezer since the absence of fat causes the scraper blades to become dull rapidly. The scraper blades must be sharpened more frequently since sharp blades favor more rapid freezing, smaller ice crystals, and a smoother product. The brine or refrigerant should be at least —10° F. and should not be turned off as soon as for freezing ice cream. Frequently by using a very cold refrigerant the desired overrun and consistency for drawing can be obtained before the re-

frigerant is shut off. Ices should have an overrun of between 25 and 30 per cent.

Controlling the overrun is very important in ices. A high overrun favors syrup drainage, a lack of firmness and poor body. Therefore stabilizers that improve whipping ability are less desirable than the gum type where it is desired to limit the overrun. Methods for controlling overrun may be listed in the following order of preference:

1. Operate freezer with colder refrigerant and longer time before refrigerant is shut off (*i.e.*, shorter whipping time).
2. Select the proper stabilizer.
3. Over-load the freezer. Use 5½ or 6 gallons of mix in a 40-quart freezer.
4. Under-load the freezer. Use 3½ or 4 gallons of mix in a 40-quart freezer.
5. Have the beater on a separate gear so that it can be made to idle while the scrapers turn.

PREPARATION OF SHERBETS

Sherbets are distinguished by having a tart or acid flavor and a low concentration of total milk solids.

Other characteristics are identical with those of ices except that the overrun is usually between 35 and 45 per cent. The importance and relative volume of sherbets is the same as for ices, but the dairyman should be more interested in selling milk solids than in selling ices. One common procedure employs fresh milk or cream to furnish the total milk solids.

A base or stock mix for sherbets consists of:

1. Between 21 and 25 lb. of sucrose (cane or beet sugar), the same as for an ice.
2. Between 7 and 9 lb. of glucose, invert sugar, or corn sugar, the same as for an ice and for similar reasons.
3. Between 0.4 and 0.6 lb. of stabilizer, the same stabilizer as used in ices and for the same reasons.
4. At least 35 to 40 lb. of milk—or enough to supply 5 or 6 lb. of total milk solids.
5. Enough water to make a total of 80 lb. of base or stock mix.

This base is prepared by slowly adding the dry ingredients to the milk and heating if necessary to obtain complete solution free from lumps. The mix need not be pasteurized provided the milk products have already been pasteurized. It should be remembered that some gum stabilizers like gum arabic will coagulate milk when heated. Therefore when using this stabilizer the milk should be pasteurized separately. Sherbet mixes are seldom homogenized, but must be cooled; and, if gelatin is used for a stabilizer, the

base should be aged for 12 to 24 hours. Then to this 80 lb. of base is added 20 lb. of the mixture of fruit juices, flavoring, coloring, citric acid solution, and water described as for making ices. Since the citric acid solution may curdle the milk, it is sometimes added at the freezer after some ice crystals have started to form.

Another common method employs ice cream mix to furnish the milk solids. In many ice cream factories ice cream mix is more easily available than is fresh milk. Furthermore, it is already pasteurized and homogenized. Since the mix supplies some sugar and stabilizer, the sherbet base must be adjusted accordingly. The following suggestions indicate the necessary changes:

1. Between 18 and 22 lb. of sucrose (cane or beet sugar).
2. Between 7 and 9 lb. of glucose, invert sugar, or corn sugar.
3. Between 0.35 and 0.55 lb. stabilizer.
4. Between 18 and 25 lb. ice cream mix to furnish approximately the same amount of total milk solids as could be obtained from fresh milk.
5. Enough water to make a total weight of 80 lb. of base mix.

The preparation of this base is the same as described for the first method, and the fruit mixture is added in the same manner. The freezing of sherbets is identical with the freezing of ices except that a higher overrun (35 to 45 per cent) is taken.

DIFFICULTIES AND DEFECTS

Control of overrun. The percentage of overrun should be kept between 25 and 30 per cent for ices and between 35 and 45 per cent for sherbets. This is not easy to do, especially if gelatin is used as the stabilizer, without modifying the ordinary routine of freezing. Agar, gums or commercial stabilizers for ices are recommended largely because they retard the rate of whipping. However, many manufacturers prefer to use gelatin because it is always on hand.

The brine should be at least −10° F. to freeze ices or sherbets and should be kept on until they are firm enough to draw. Usually a very cold brine makes it possible to draw a low enough overrun. If not, the freezer must be over-loaded or under-loaded, or the beater must be on a separate gear so that it can be made to idle. Over-loading the freezer is the usual procedure followed to control the overrun.

Firmness at dipping temperature. Ices and sherbets should be of the same firmness, at ordinary cabinet temperatures as ice cream since they usually are sold from the same cabinets. If the overrun is kept between 30 and 35 per cent and the sugar content at 28 to 32 per cent, the firmness will be suitable for dipping at the usual cabinet temperatures of 3° to 8° F.

Excessive coarseness. Undue coarseness may be prevented by keeping the sugar content between 28 and 32 per cent; using about one-fourth of the sugar as corn sugar; using the right amount and kind of stabilizer; drawing from the freezer in a firm condition; and marketing promptly. The base should be aged for 12 to 24 hours and enough stabilizer should be used to cause a partial gelling at cold room temperatures.

"Bleeding" is the term applied to the settling of the sugar syrup to the bottom of the can. The usual causes are: excessive overrun; insufficient stabilizer; too much sugar (over 32 per cent); too high temperatures in the cabinet.

Surface crust sometimes forms on ices and sherbets. This is due to surface evaporation of moisture and can be prevented by covering with parchment paper and can cover. If about one-fourth of the sugar is corn sugar, a surface crust will not occur. With cane sugar alone as the sweetener, this trouble more often occurs.

CHAPTER XVI

FANCY MOLDED ICE CREAMS, NOVELTIES AND SPECIALS

Very early in the history of the ice cream industry the small manufacturer with imagination often emphasized the possibilities and profits to be gained in making Fancy Ice Creams and Novelties. But the larger manufacturer, in many instances, seems to have been a little slow in pushing this class of ice cream, due largely, perhaps, to the high cost of the skilled labor involved. However, recent advances in equipment for making, filling, and decorating indicate the possibility of mass production at lower cost which should make the future for this type of business very bright.

FANCY MOLDED ICE CREAM

Ice cream belonging to the class known as Fancy Molded Ice Cream differs from plain bulk ice cream chiefly in the form in which it is marketed. In some cases there may be a slight difference in the formula but the principal difference is in the manner of coloring, and in the size and form of package.

Difference in formula consists usually of the addition of a little more stabilizer or a little more milk solids in order to obtain a firmer body.

The difference in package is one of the distinguishing features of fancy ice cream. The most common package or form is the quart brick, easy to cut and serve. The individual cup mold (enough to serve one person) is also popular. However, much ice cream is molded in the form of animals, statues, flowers, fruits, or other objects. The mold may be of individual size or it may contain a number of quarts of ice cream.

Calculated to increase sales and also to reach a different clientele, the fancy molded ice creams are generally made for special occasions—parties, balls, banquets, and the like. Here the ice cream maker with imagination and artistic ingenuity can be of great help to the hostess or chef in carrying out a special design or color scheme in the party dessert. Success in this line requires no small amount of originality and artistic taste, which are rewarded by the better price and increased demand for these fancy products. Never forget that the customer is willing to pay a special price for something new and appropriate for the occasion, and the ice cream maker capable of giving these suggestions is sure of increasing the demand for his product if he exercises good taste in every sense of the word.

Harmony in color and flavor is of great importance in bulk as well as in fancy ice cream. Colors and flavors should therefore be selected with great care. That is to say, the color must suggest the flavor and must harmonize

with it. For example, a vanilla ice cream is yellowish (creamy in color), but a strawberry ice cream is pink because that is the color imparted to the cream by the natural fresh strawberry fruit. Fruits often do not color the mix sufficiently so it is customary to add enough coloring to remind one of the natural color of the fruit. But it would most certainly be a bad combination of colors and flavors if one were to color vanilla ice cream pink or strawberry ice cream brown. Not that coloring adds or detracts from the flavor, but unless the two harmonize, there is nothing suggestive in the color.

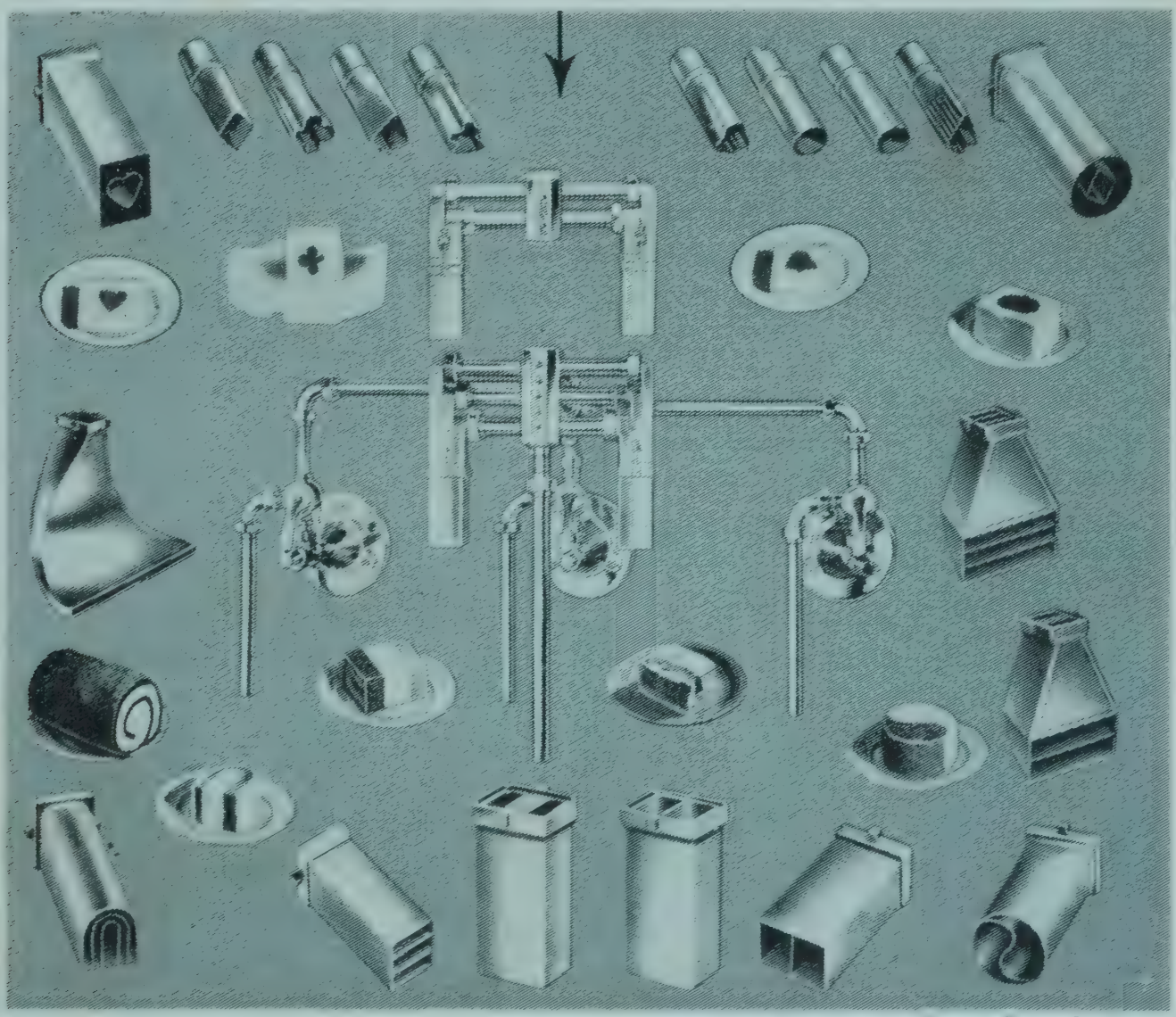
The color, however, should not be too deep, for that suggests artificiality and cheapness. Light and dainty tints are the most pleasing to the eye. Therefore, color should be used sparingly.

Flavor and Color Combinations. Most of the fancy ice creams are composed of two or more flavors and colors of ice cream combined in such a manner that each serving will consist of proportionate amounts of each. For example, the rainbow or variegated effects produced by carefully marbling or veining several colors of creams as they are drawn from the freezers into the molds or packages; or the aufaits, produced by combining a pectinized fruit, in either layered or rippled design, with a plain ice cream; or ice cream combined with sherbets or ices in alternate layers. Ice cream may also be used in combination with bakery products as in the cake rolls, and it may be coated with chocolate or other frostings, as in the well-known chocolate bar. Each or all of this great variety of combinations of colors and flavors may be molded into a variety of shapes and forms, ranging from the well-known two or three-layer brick to the most intricate flower or geometric designs. These fancy molds or shapes are frequently used in carry-out packages, as individual servings of two ounces or more, or in packages up to two or three quarts.

These carry-out packages may be filled directly from the filling machines or from the continuous freezer by means of special nozzles of the proper size and shape, designed so as to deliver the right proportions of the different color and flavor combinations desired in the mold. The continuous freezer permits drawing the ice cream at a colder temperature and thereby producing sharper dividing lines between the different flavored creams as they are filled into the molds or packages.

Brick Ice Cream. Of the many fancy molds for ice cream the brick is perhaps the most popular. In large up-to-date ice cream plants bricks are usually made in four or eight quart capacity metal trays or molds. Paper trays set in wire baskets to hold them in shape are also used. The trays are filled with quite firmly frozen ice cream direct from the freezer and are

quickly placed in the hardening rooms. Usually only two slabs are filled from a 40-quart batch, the rest of the batch being drawn into a 5-gallon package, thus avoiding too much variation in overrun. The trays may be filled with just one layer of ice cream or there may be two or three layers, giving a chance for three different flavors and as many different colors in the brick. In order that the layers may show up distinctly and with sharp outlines, the first layer must, of course, be properly leveled off and hardened before a second layer is added.



Courtesy, Cherry-Burrell Corp.

Fig. 27. Fancy Mold attachments for Vogt freezer.

When the ice cream is sufficiently hardened, the trays are defrosted by immersing in lukewarm water just long enough to loosen the slabs of ice cream. The covers are then removed and the trays inverted on the cutting table. In trays having holes in the bottom, air is sometimes blown in to facilitate removal of the ice cream slabs. When paper trays are used the slabs are easily removed without defrosting. As soon as the slabs are removed, they are cut in brick size, wrapped in parchment and placed in

waxed cartons, and then hardened again. The cutting of the bricks is easily done by following impressions in the slabs left by ridges in the trays which indicate the size of the brick. The whole operation should be done quickly or the ice cream will soften and give the brick a messy appearance.

Quart and pint sized metal brick molds are used only in making very limited quantitites. These are usually filled by dipping ice cream from the 5-gallon package as soon as the ice cream is drawn from the freezer. The molds are then hardened and defrosted in the same manner described for the slabs.

Individual molds such as animals, flowers, *etc.,* are filled by dipping the ice cream from a bulk package, usually, a 5-gallon can. Large molds and center molds may also be filled in this manner. The best procedure is to fill the molds immediately after the ice cream is drawn from the freezer, while it is soft and has time neither to melt nor to harden appreciably. When this is not feasible, the already hardened ice cream may be softened to the usual serving temperature (3° to 8° F) of retail cabinets, and then dipped into the molds. When this hardened ice cream is used, care must be taken to avoid packing the cream too firmly because the solidly packed ice cream will be difficult to cut for eating.



Courtesy, Zenker School of Cake Decorating, Chicago.

Fig. 28. Ice Cream Cake decorated with whipped cream borders, sweet peas, and rose, including the lattice work which is made with chocolate whipped cream. An artistic job.

Ice Cream Cake—How Made. Ice cream cakes are made in much the same way as the brick. For the form use any ordinary cake pan. Cut a round hole the size of a dime in the center of the pan. This makes it easier to remove the frozen cake from the pan. Cover the hole with parchment paper before filling with ice cream. Fill about as in making brick ice cream. If the cake is to have several layers, it can still be made in a deep cake pan by letting the first layer harden before filling in the second, and so on for the third, taking care that each layer is hardened before the next one is poured in. Here the ice cream maker can use his ingenuity in stacking the layers so as to have an artistic arrangement of colors and flavors. When the cake has been properly hardened it is ready to be defrosted and decorated.

Special molds for making a pre-cut cake are being made. This new, quick method enables the operator to fill segmented molds direct from the freezer or from the hopper. This new development apparently will eliminate or reduce many manufacturing problems and also will provide pre-cut portions that can easily be separated when the cake reaches the consumer.

Ice Cream Pies. In small quantities ice cream pies are usually made by shaping and hardening a half-inch layer of slightly caramel-colored vanilla ice cream in a common pie plate. The shaping is more naturalistic if a second pie plate is set in the first with the ice cream between them while the hardening is taking place. They may be made as one-crust or as two-crust pies. After the crusts are hardened they may be filled with fruit ice cream or any other specially flavored ice cream, or with preserved fruits which have first been hardened in a pie plate of a size to fit into the crust. If there is to be a top crust this is carefully inverted over the filling layer and the pie is ready for the decorator. The top surface of the pie is usually decorated with meringue or with whipped cream and given an oven-browned appearance by lightly spraying on with an atomizer a suitable coloring material.

Where pies are made in large quantities rigid paper pie plates are used. When these have been filled they are set in tin plates for easier handling, the filling is piped in right from the continuous freezer, and the top smoothed over with a spatula before the pie is sent to the decorating table.

If a fruit center is to be used the crust of ice cream is shaped in the plate, and the hardened fruit center from the small pie plate, as described above, is fitted into it, a second layer of ice cream is piped on top and smoothed over with a spatula, and the pie is decorated as desired.

These pies and cakes are often successfully worked in as week-end or holiday specials. They lend themselves nicely to many different flavor and color combinations. Vanilla, strawberry, caramel, banana, and chocolate seem to be most popular but this may vary in different localities.

DECORATING

In the past much of the decorating of fancy ice creams was done by hand and by the use of various forms and screens. However, now in general commercial practice the decorating tool is a cone-shaped bag made of parchment paper into the tip of which is inserted the metal points or nozzles



Courtesy, Zenker School of Cake Decorating.

Fig. 29. Step by step in the making of roses.

through which the cream is extruded and laid down on the cake surface. These points or nozzles, which come in various shapes such as cord, ribbon, leaf, rose, star, can be secured from dairy supply houses.

The cone-shaped bag is made by rolling the paper into a cone; just enough of the tip of the cone is cut off to allow the nozzle point to be inserted from the inside. The top flap of the cone is left on to be turned down over the top after the bag has been filled. The bag is filled with the decorating media, whipped cream, and grasped in the right hand. Using the left hand as a rest for the right wrist, the bag is squeezed enough to extrude the cream at the same time that the nozzle is moved forward over the cake to lay down the desired design. The actual process is not easy to describe

but the art is easily acquired even by the novice, especially if he is gifted with artistic sense. He should, however, seek the opportunity of watching a skilled decorator at work. Plenty of practice is needed before a perfect job can be expected. Mashed potatoes are an excellent substitute for whipped



Courtesy, Zenker School of Cake Decorating.

Fig. 30. Making such flowers as Foget-me-nots, rose-buds, sweet peas and pinks. Read from top line down.

cream in obtaining this needed practice. After the artist has acquired proficiency in handling a one-color job, a two-color job may be attempted. By carefully filling one side of the parchment bag with one color and the other side with a second color of whipped cream, a two-color effect can be produced as the cream is squeezed through the nozzle. In general, the decorator prefers to make up several bags, one for each of the colors he intends to use, or for the various shapes of nozzles he needs for his designs.

Ice cream decorators like a small turntable on which to place the cake or pie or brick to be decorated. This facilitates working all around the cake without disturbing its position. Such a turntable is easily made by using a block of wood 6 or 8 inches high for the pedestal to which is nailed rather

loosely a smooth round board for the table top. The cake is placed on the turntable and is first smoothed over with a thin coating of whipped cream applied with an ordinary spatula. A 45 per cent cream which has been aged for at least 48 hours, chilled to 40° F., then whipped to a smooth consistency, not too thick so it becomes grainy or buttery, nor so thin that it runs off the cake, is most satisfactory for decorating. To make it more palatable 5 per cent of sugar and a little vanilla or other flavoring may be added. This cream can be tinted in any desired color with flavor to harmonize, and the designs in which it can be shaped are limited only by the skill and artistic ingenuity of the decorator.



Courtesy, Zenker School of Cake Decorating.

Fig. 31. Other examples of the decorator's art.

Other frostings may be used for special purposes. This thin, smooth coating to cover the surface of a mold may be made of cream, coloring, sugar, and stabilizer to give a fairly heavy batter, but not whipped. The cake, or other mold, is quickly dipped in the batter, or the batter poured over it and the excess allowed to drain off. Butter frosting prepared by mixing butter, sugar, color, and flavor is also effectively used.

Special effects are obtained in a variety of ways. The "fuzzy" coloring effect on peaches may be obtained by chilling the molded cream on dry ice and then spraying it with colored water from an atomizer. A shiny glazed surface may be obtained by chilling the molded cream on dry ice and then briefly dipping it in water which may or may not be colored. Silhouette effects may be obtained by stencils as described on page 167.

NOVELTIES

The manufacturer who puts out ice cream novelties generally has an inside track with people and especially with the children of his community

and he receives more per gallon for his frozen product in the form of novelties than in any form of bulk ice cream. Classed as novelties are fancy center brick molds, melon molds, logs, individual molds in endless variety, and all such special products as are hardened and served in paper molds and in Dixie cups. Also included in this class are chocolate covered ice cream bars, walking sundaes, take-home sundaes, frosted malteds, popsicles, *etc.*, all of which are very popular with many groups and offer a good way of successfully competing with soft drinks and certain confections. While these novelties and fancy ice creams are sometimes classed as something of a nuisance and mean extra work for the manufacturer, they are very helpful in creating good will for his trade, especially for such events as weddings; anniversary parties; Thanksgiving, Christmas, New Year's, Washington and Lincoln Birthday celebrations; family birthday parties; and many others, and they help stretch the ice cream season well into or through the winter months. Thus they all help to build up gallonage.

Center Mold Bricks. Center brick molds are very popular. There are several ways in which these can be made. First of these is the fancy center mold which is made in two parts—the outside can or shell in brick form and the inside core open at both ends made in the form of the desired design when seen in cross section. This core is attached to one of the lids. In making the brick one cover lined with parchment paper is securely fastened over the end of the form which is then inverted and filled to within an inch and a half of the top with fairly soft ice cream of the kind desired for the main part of the brick. The center core attached to the other cover is then pressed down into this filled form until the cover comes into place. The cover keeps the center core exactly centered. The form is then refrigerated. When hardened sufficiently, cool or lukewarm water is poured into the center core to loosen it so that it can easily be pulled out leaving a hole through the center of the brick the shape of the desired fancy center. This hole or space is then filled with the ice cream of the desired color and flavor planned for the center. This must be quite soft (soupy) so as to readily fill all the space left by the removal of the center core. The cover is then put on and the form is again refrigerated until ready for wrapping and packaging.

In another type of center mold the fancy centers are frozen first in a separate mold. They are then removed and imbedded in the lightly frozen ice cream used for the body of the quart brick. If eight-quart molds are used, much care must be taken to see that each piece is properly imbedded so as to appear in exactly the right place in each of the eight bricks.

Still another way is sometimes resorted to for quick work. It makes use of a center design mold something on the order of a cookie cutter. This is punched down through the center of the brick lengthwise and the hollow

thus created is then filled with mix of the desired color for the center design.

Fancy Centers with the Continuous Freezer. The extra stiffness of continuous freezer frozen ice cream opens up many new possibilities as to both speed and economy. These continuous freezers fitted with special shaped discharge tubes now make it possible to deliver the ice cream in layers of one, two, or three colors in brick molds. It also makes it possible to put fancy centers in many different types of packages. To deliver three different colors simultaneously three freezers must of course be hooked up and operated as one battery, delivering the different colored ice cream in the exact proportions wanted in each layer. To get good sharp outlines it is best to have the ice cream flowing through the center stiff enough to retain clear-cut form and outline. Freezer manufacturers will gladly furnish full information and details as to the many specially designed tubes available. Among the more popular designs for center brick molds are: Lodge, club and class emblems; class numerals; spade, heart, diamond, and clubs; Washington and Lincoln busts; Santa Claus; turkey, hatchet, cherries, rose, lily *etc.*

NOVELTIES POPULAR IN SOME PARTS OF THE COUNTRY

Rainbow Ice Cream made by carefully mixing (marble cake fashion) several different colors, as the product is drawn from the freezer.

Rainbow Cones made by putting thin spoonings of six or eight different colors of ice cream on top of each other, cone fashion.

Spumoni, a fancy ice cream, is generally made in cupshaped form in pint or quart size. The outside layer is usually made of vanilla ice cream. In the bottom of this shell is placed macaroon or chocolate mousse and this is topped with tutti-frutti mousse. In serving, it is cut in wedge shaped pieces like cake.

Ice Cream Tarts are made from vanilla brick, cut into eight slices, and again cut in halves trianglewise. A small dent is made in the center of one triangle and the depression filled with some highly colored fruit; the second triangle is fitted over this, the sides are smoothed up, and the top sprinkled lightly with bisque crumbs. The tart thus formed is wrapped in wax paper and placed in the hardening room.

Ice Cream Waffles are made in waffle shaped molds which generally come in a size to make six or eight to the quart. These molds are filled with vanilla ice cream. When hardened the molds are removed, both sides of the waffle are covered with bisque crumbs, and two of these are placed together, and wrapped in wax paper until ready to be served.

Many of the novelties quite worth while are controlled by patents held by commercial companies who sell licenses to those interested. To protect



Courtesy, Manuel L. Hendler, Hendler Creamery Co.

Fig. 32. The Box of Strawberries (Miniature novelty). These delicious strawberry ice creams cleverly resemble nice, ripe, natural strawberries. The coating is a nearly perfect counterpart of the natural berry both in color and flavor, and each berry has its green stem decoration. To complete the illusion they come packed in an ordinary quart-size strawberry box from which they are to be served. A novelty for children's parties and other small at home parties.



Courtesy, Manuel L. Hendler, Hendler Creamery Co.

Fig. 33. The Ice Bowl of Assorted Fruit (miniature novelty). Bowl of almost crystal clear ice is filled with individual ice creams flavored, molded, colored, and decorated to resemble miniature assorted fruits. Served in the ice bowl this is a surprisingly appealing dessert for special occasions.



Courtesy, Manuel L. Hendler, Hendler Creamery Co.

Fig. 34. Box of Bon-bons. The transparent semi-plastic box contains an assortment of ice creams of a variety of flavors, cut and molded into various shapes and decorated to resemble a box of fancy assorted candy bon-bons. Very attractive and especially suitable for special gifts for birthdays, for hospital patients and other occasions.



Courtesy, Manuel L. Hendler, Hendler Creamery Co.

Fig. 35. A Bowl of Walnuts. The walnut ice cream in this novelty is very cleverly shaped and decorated to appear as natural walnuts. The wooden bowl comes packaged with the ice cream. A specialty for men's parties.

Fig. 36. ICE CREAM IN ALL ITS GLORY folder which is a good example of the kind of publicity which may be helpful in increasing the sale of fancy molded novelties and specials and in stretching the ice cream season through the year, is one of the best that has come to the authors' attention. It should help the reader in developing new ideas for specials and novelties suitable for his community. The Hendler Creamery Company of Baltimore are among the leaders in developing fine novelties in the way of delicious desserts.

Hendlers
ICE CREAM
IN ALL ITS GLORY



THE PURPOSE OF THIS FOLDER is to offer the busy hostess a few helpful suggestions about the many ways of serving this popular dessert, and to remind her of the many special molds and decorative designs which are most fitting for every occasion and season.

. . . SUCH GRAND CELEBRATIONS DESERVE THE FINEST



Christmas and New Year

It's a festive Christmas dinner inde
if dessert time brings any one o
large assortment of molded ice crea
to the table.

Christmas Tree Brick
Christmas Ice Cream Cake
Yule Log — 8 to 10 servings

MOLDS

Santa Claus
Christmas Bell
Candlestick
Poinsettia
Turkey
Holly Wreat
Stocking

NEW YEAR'S DAY

Cupid
Candlesticks
New Year's Baby
New Year's Ice Cream Cake
Bell Mold
Holly Wreath
Poinsettias

CHARMING IN FORM AND COLOR



Hallowe'en and Thanksgiving Day

The fall season brings with it a rou
of parties. Two days especially
Hallowe'en and Thanksgiving—
for a round of festivity to wh
we add the crowning touch of a
lightful variety of ice cream mol

FOR HALLOWE'EN

Pumpkin
Witch
Apple
Ear of Corn
Candlestick
Pumpkin Center B

FOR THANKSGIVING

Turkey
Chrysanthemum
Roast Turkey
Horn of Plenty
Pumpkin
Ear of Corn
Football
Corn in Husk

MAKE THESE DESSERTS AT HOME



FOR CONVENIENCE IN HOME SERVING, ALWAYS GET

HENDLERS "FAMILY TREAT" PINT PACKAGE

"The Very Best Ice Cream in Town"



HEAVENLY PUDDING. Over mound of vanilla ice cream, spread a layer of macaroons ground fine. Top with whipped cream, and garnish with small slices of pineapple.

MAY BLOSSOM. Split lady fingers and dip one end of each piece into thin, pink frosting. Arrange petal fashion around sherbet glass. Fill center with vanilla or chocolate ice cream. Sprinkle with crushed red and white peppermint candy.

HARVEST GLAZE. Cook dried apricots. Rub through sieve. Add equal quantity of sugar. Cook clear, pour hot over ice cream. Garnish with chopped almonds.

FROSTED STRAWBERRY BRICK. Fill cold, waxed-paper-lined ice cube tray with 1 quart strawberry ice cream. Pile 1 cup whipped cream on top. Place in freezing compartment to harden for 2 to 3 hours. Lift from tray; remove waxed paper; decorate with slices of fresh strawberries. Cut and serve.

BAKED ALASKA. Place brick of hard ice cream on one inch thick layer of sponge or angel cake. The cake should be an inch larger than the ice cream all around. Make meringue by adding one-half cup cold water to six egg whites. Beat stiff, add six tablespoons sugar, one-fourth teaspoon salt, one-half teaspoon vanilla. Beat until it will form points. Completely cover ice cream and cake. Leave surface rough. Be sure there are no air holes. Sprinkle with sugar, bake in hot oven, 450°, five minutes. Serve at once.

ICE CREAM PIE. Roll pie crust one-quarter-inch thick, line pie plate. Bake. Cool. When ready to serve, fill shell with hard ice cream of any flavor. Cover roughly with meringue (see baked Alaska). Bake at 450° for five minutes. Serve at once.

PARFAITS. Buy smaller quantities of several kinds of ice cream. Combine as desired with fruits and sauces. An infinite variety challenges the imagination and satisfies the palate.

ICE CREAM BASKETS. Cut inch sheet of sponge cake into five or six inch squares. Cut off corners. Sprinkle thickly with powdered sugar. While still warm, press down into large muffin pans. When perfectly cold, remove, fill with ice cream and garnish with any desired fruit or sauce.



PEACH MELBA. Fill basket or cover slice of cake with half peach pit side up. Top with ball of ice cream. Cover with raspberry juice, sweetened and slightly thickened with cornstarch. Garnish with whipped cream.

ICE CREAM AND CANTALOUPE. Always popular in the cantaloupe season. It is easily and quickly served by placing a large dipper of ice cream in the hollowed center of a half cantaloupe.

ORANGE CLOUD. Place a scoop of orange ice in sherbet glass. When ready to serve, fill glass with lemonade. Drop in a red maraschino cherry.

BLUSHING BUNNY. Fill glass with strawberry soda and top with ball of strawberry ice cream.

ROOT BEER FLOAT. Whip a glass of root beer with one scoop vanilla ice cream. Top with another.

GINGORANGE. Half fill glass with orange juice. Fill with gingerale and top with ball of orange sherbet.

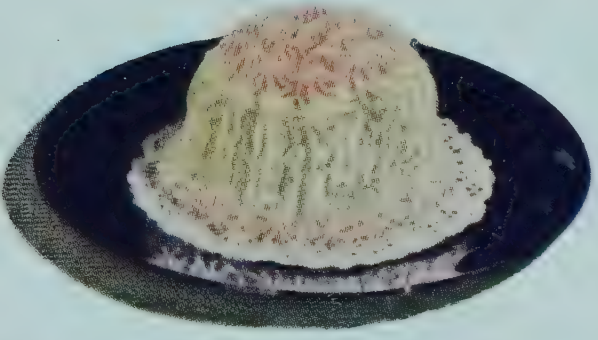
FROSTED GRAPEFRUIT JUICE. One pint orange ice, two pints grapefruit juice, six lumps sugar, six mint sprigs and a few mint leaves. Chill the grapefruit juice. Press a mint leaf against each lump of sugar and drop into glasses. Put a scoop of orange ice in each glass and pour in the grapefruit juice. Garnish with a sprig of mint. Add more sugar if desired.

GINGER PINEAPPLE. Place two tablespoons crushed pineapple in glass. Fill with gingerale, top with ball of pineapple or orange sherbet.

TANTALIZINGLY D



DECORATED SLICES — The theme of your party — the emblem of your organization — the crest of your sorority — embellished on an ice cream slice and artistically decorated with whipped cream—that is the answer to many, many questions of what to serve for dessert at lodges, clubs and organization meetings and banquets.



ICE CREAM BOMB (Serves Eight) — This large single piece will serve eight generous portions and can be made in flavors of your own selection.

THE SUCCESSFU

. . . Know

Originality is the secret of success in mode entertaining. Today more than ever befo the popular hostess is on the watch for som thing new and distinctive for her party r freshments.

Here you will find many suggestions to ac to the success of Afternoon Teas, Brid Parties, Dinners, Weddings, Banquet



MOTHER'S DAY ICE CREAM CAKE— The inspiration for Hendlers Mother's Da Cake was derived from Whistler's celebrate painting "Mother," for which his ow mother posed.

The cake is made of two layers of differe flavors of ice cream, artistically decorate with whipped cream. Comes in three siz — serves 8, 12 and 16.

YOUR ORDER PLACED 48 HOURS IN A

ICIOUS DESSERTS

HOSTESS
e Value of Surprise

eptions, Anniversaries, Children's Parties
many other occasions.

make special designs in ice cream to or-
and are continually creating new combi-
ons and designs. Many are not pictured or
ribed in this booklet. If you are seeking
ething fitting a particular occasion we in-
you to call your Hendler dealer or your
er.



ICE CREAM CAKES — For Birthdays, Anniversaries, Dinner Parties. A lovely centerpiece for your table that becomes a delicious dessert—that is the dual purpose of this ice cream cake. These cakes are made in two or three layers of different flavored ice creams, decorated to suit the occasion with whipped cream. Ice Cream Cakes are made in sizes to serve 10, 14 and 24 portions.



CREAM CAKES FOR SPECIAL OC-IONS — Photographs, lodge emblems, ol colors — in fact, ANY subject can aithfully reproduced by us on ice cream s or individual blocks.



SULTANA ROLL—The center is filled with fruits or sherbet, around this is a layer of rich, creamy vanilla ice cream and all is rolled in Toasted Pecan meats—Pecans that have been toasted brown in butter. If you have never tried this, you have a very pleasant surprise coming. Each roll will serve ten.

NCE WILL ASSURE DELIVERY ON TIME



For Children's Parties

Animals, Toys, Birds.

What could be more appropriate for children than these.

An ideal way to serve these individual molds is to have a parade.

Serve each child with a different animal and what a lot of fun it will be.

All children love animals and ice cream.

HENDLERS "THE VELVET KIND" ICE CREAM

Ice Cream Pies

An ice cream crust filled with delicious frozen fruit ice cream — daintily decorated with whipped cream. The discovery by your guests that an apparently perfect-looking pie is made with ice cream always lends an element of surprise to these servings. Ten can be served from one ice cream pie.



EEPING Tested and Approved by Good Housekeeping Bureau GOOD HOUSEKEEPING MAGAZINE **SEAL OF APPROVAL**



For the Bride!

Weddings, announcement parties, showers and anniversaries are reasons for entertaining in the "grandest manner." Here ice cream is a great favorite because of the many beautiful and appropriate molds to be had. Some brides choose roses in white, pale pink, or yellow to match their table decorations. The heart and cupid heart molds are both favorites. The vogue of white weddings has made the lovely calla lily and the white wedding bell molds more popular than ever. And nothing is more appropriate than the good luck slipper.

HARMONIZING WITH EVERY FESTIVITY



Easter

Brings thoughts of spring, gayly colored Easter Eggs and beautiful Easter Lilies. Here they are just as they will look upon your table.

EASTER MOLDS

Rabbit	Easter Lily
Chicken	Calla Lily
Chicken in Egg	Cupid
Egg Center Brick	Easter Egg
Hen in Nest	Rooster

Kendlers ICE CREAM The Velvet Kind

Awarded GOOD HOUSEK

CALENDAR OF FANCY MOLDS

FLOWERS

Rose, Carnation, Shamrock
Cosmos, Calla Lily, Clover
Orchid, Pansy, Pond Lily
Easter Lily, Wild Rose
Chrysanthemum, Maple Leaf
Poinsettia, Orange Blossoms
American Beauty Rose

FRUITS

Pear, Peach
Apple, Banana
Watermelon, Orange
Pineapple, Cantaloupe
Bunch of Grapes

VEGETABLES

Ear of Corn, Corn on Husk
Pumpkin, Tomato
Potato, Carrot
Asparagus, Lima Bean
Peas in Pod

ANIMALS

Lion, Rabbit, Chicken
Pig, Duck, Elephant
Frog, Horse, Butterfly
Dog, Dove, Eagle
Rooster, Cow, Donkey
Lamb, Owl, Boar
Swan, Turkey Alive
Roast Turkey, Puss in Shoe
Fish, Teddy Bear

STORK SHOWER

Baby, Kewpie
Cradle, Stork
Baby Shoes

ST. PATRICK'S DAY

Shamrock, Irish Harp
Irishman, Pipe

HALLOWE'EN

Pumpkin, Corn on Husk
Candlestick, Kewpie
Apple, Owl
Witch (riding broom)

THANKSGIVING

Pumpkin, Roast Turkey
Turkey Alive, Corn on Husk
Ear of Corn, Horn of Plenty
Football

CHRISTMAS

Santa Claus, Christmas Bell
Holly Leaf, Christmas Tree
Poinsettia, Holly Wreath
Stocking

BRIDAL AND WEDDING ASSORTMENT

Wedding Bells, Cupid on Heart
Cupid Alone, Cupid in Rose
Cooing Doves, Slippers
Plain Heart, Engagement Ring
Bible, Bride
Groom, Goodluck Horseshoe
Cupid with Bow and Arrow
Wedding Ring

NEW YEAR'S DAY

Cupid, Poinsettia
Holly Wreath, Candlestick
New Year's Baby

VALENTINE'S DAY

Cupid with Bow and Arrow
Cupid Alone, Cupid on Heart
Kewpie, Plain Heart
Valentine Envelope

LINCOLN'S BIRTHDAY

Flag, Eagle, Liberty Bell

WASHINGTON'S BIRTHDAY

Hatchet, Flag, Eagle
American Flag, Uncle Sam
George Washington
Martha Washington

MEMORIAL DAY

American Flag, Soldier
American Eagle, Uncle Sam
Liberty Bell

EASTER ASSORTMENT

Easter Lily, Calla Lily
Chick in Shell, Cupid
Chicken, Rabbit
Rooster, Chicken on Ne

CARD PARTY

Ace, King, Queen and Jack
Hearts, Spades, Diamonds a
Clubs

MISCELLANEOUS

Football, Airplane, Auto
Train, Clown, Basket
Bicycle, Banjo, Cannon
Violin, Indian, Boat
Fire Engine, Policema
Baskets, Golf B

UNIQUE MOLDS OF ICE CREAM

Old-fashioned Bouquet
Old-fashioned Lady
Individual Basket of fruits
Individual Basket of flowers
Cup and saucer

PIES — Ice Cream Pies are ma
in any combination of ice cre
and ices, suitably decorated w
whipped cream. Serves 1

**Large Ice Cream Molds That W
Serve Several People Are Ve
Suitable for Small Parties.**

WATERMELON MOLD
Serves 8, 12 or 16

LOG ROLL — Serves 10
PUMPKIN MOLD — Serves
VALENTINE OR HEART MOLD — Serves 10 or 16

FANCY CENTER BRICK

Gallon Serves 24 to 32
Heart, Pumpkin
Egg, Christmas Tree

Ice cream should not be eaten too hard. Its true richness and delicious flavor can only be obtained if allowed to mellow.

ORDER

"PARTY DAINTIES"

THROUGH YOUR HENDLER DEALER OR YOUR CATERER

PLEASE ORDER 48 HOURS IN ADVANCE OF TIME WANTED

MINIMUM QUANTITY, ONE DOZEN **DELIVERED IN DRY PACKAGE**

these products and to insure uniformity, the licensor insists on standard formulas and standard trade marks. Among these novelties are Eskimo Pie, Popsicle, Fudgsicle, Creamsicle, Drumstick, Chocolate Bar, *etc.* The licensor generally has special equipment, packages, flavoring, formulas with detailed directions, as well as advertising matter, available to those interested in making the type of product.

SPECIALS

Too many ice cream businesses, like certain animals, hibernate during the winter months. This should not be the case with this business, for ice cream is the universal dessert, one that is good at all seasons of the year. During the cool weather of the winter season, why not put extra stress on the fact that ice cream abounds in fats which carry the vitamins so necessary to build up resistance against the many infections that plague us during the winter?

Sell Idea. The ice cream manufacturer should make it his job to sell these ideas regarding the value of ice cream to the consumers in his territory just as the people who grow and handle lettuce, citrus fruits, *etc.,* have spent money in putting their ideas across, with the result that copious quantities of these products are now being consumed.

Even though advertising is effective, it is well to remember that people tire of the same diet, and the ice cream maker, like the good chef, should be constantly on the alert for new ways in which to present his wares. He should vary the flavors and the style of his product, for no matter how good a food may be, if it appears on the menu too often in the same form or flavor, it becomes monotonous.

More of an attempt should be made to look at things from the busy housewife's point of view. Encourage her in her desire to have something new both as regards flavor and style of product. Help her develop new ideas, new names, new specials, for different seasons, and even weeks of the year, to keep consumer interest from lagging.

Among progressive ice cream people there is plenty of evidence to indicate that if special flavors are pushed when they are in season, and fancy ice creams and novelties are developed and offered as they synchronize with the various holidays and festive occasions, business is very materially increased. Although catering to this new demand requires some energy and some originality, many ice cream manufacturers can make use of some of these suggestions to help their particular local business.

Any progressive manufacturer can offer the consumer some variety in ice cream specials. Ordinarily it is not considered wise for the small concern to carry too many kinds of ice cream at one time. Rather, it should be good

business to carry less variety but to have a definite plan of something new and special at least each week and for the special holidays and festive occasions that are being observed in his locality. There are many ice creams containing certain fruits and nuts that can be featured at the appropriate time of the year.

The large ice cream factories make countless different individual molds varying in shape, of which the following are samples: flowers such as the rose and the lily; Washington and Lincoln busts; dogs and horses; heart, spade, club, and diamond; Masonic, K. of C., Rotary, Kiwanis, and numerous other emblems. The dairy supply houses list many more and generally they will make up any design the ice cream maker may wish.

Increase Consumption. Although in most surveys vanilla ranks first, with strawberry and chocolate as runners-up, the manufacture of new and special products should be considered a good practical way to increase the per capita consumption of ice cream. While certain flavors may be almost unknown in one territory, if properly introduced and advertised they may prove to be quite popular and very materially assist in increasing ice cream consumption and stretching the season, so that the demand for ice cream will be more uniform throughout the year.

Be constantly on the alert for new and popular flavors for ice cream use. Study the reaction of the consuming public to them. If in trying out a score of new flavors one or two real hits are found, the experiments and effort are well repaid. Of course, have enough of the standard flavors on hand to take care of the demands of loyal customers.

Many manufacturers in widely scattered sections of the country have taken advantage of new flavor appeals to increase their local business. Thus, coffee has become a favorite in New England, and maple a good seller in Canada. Prune ice cream is now successful in California, and ginger ice cream is popular among certain nationalities.

Combinations. Various new combinations of fruits develop appealing flavors for ice cream specials. As examples, pineapple combinations such as grape-pineapple, mint-pineapple, orange-pineapple, pineapple marshmallow prisms, glacé cherry-pecan mix of pineapple, nuts, raisins, and cherries. Caramel flavor combinations offer other attractive specials as well as do candies and candy-nut combinations such as buttercrunch, butterscotch, peppermint, lemon drops, butter toffee, maple pecan, pecan crunch, and the like.

Party List. Some hustling ice cream firms have found it well worth while to keep a list of birthdays of children and prominent people in their territory. At just the right time the salesman may call the attention of the housewife to the possibility of ice cream in celebrating the occasion.

Here's a suggested list of fancy ice cream specials for gatherings of various kinds:

For Weddings and Showers.

Decorated Cake.

Individual molds such as slipper, bell, dove, bride and groom, tulip, heart, cupid, ring, *etc.*

For Baby Showers.

Decorated cake with emblems such as stork and baby.

Individuals of the same design.

For Bridge Parties.

Decorated cake.

Individual molds of ace of hearts, clubs, spades, and diamonds.

Sometimes a stencil with similar designs can be used very satisfactorily on sliced bricks.

For Birthdays.

Decorated cake with Happy Birthday and sometimes with numerals.

Many individual molds with the stenciled numerals indicating age, class, *etc.*

For Children's Parties.

Individual molds of elephant, engine, horse, butterfly, monkey, boat, cannon, *etc.*, are some of the possibilities.

For Athletic Functions.

Ice cream cake in the form of a football or basketball.

Individual forms showing an athlete or a football.

Layer Bricks. Two- or three-layered colored bricks are good sellers but should not be overdone as people tire of this type of ice cream if used too often. There are many possibilities in special designed bricks, sliced bricks, individual size, *etc.* Slice a quart of ice cream into six or eight portions, depending on the size wanted. For a neat job, cover each with whipped cream, chill, and use stencil for lettering and decorating. (There are many firms that can supply celluloid stencils of any design for either individuals or cakes). Special colored whipped cream is spread over the stencil design with a spatula and the celluloid stencil quickly removed before it freezes to either the ice cream or the whipped cream design. When the stencil is removed, the sharp colored outline of the pattern will remain. The decorated pieces are hardened in the hardening room and then placed in glassene bags for protection.

Gelatin Cubes. Another new way of attracting trade is by introducing a very appealing and attractive specialty—fruit-flavored gelatin cubes—

which lend a new, distinct, and delicious flavor and color to ice cream. The fruit-flavored gelatin is made a little firmer than the usual jello pudding and then cut into cubes. These true fruit cubes of gelatin have been used in bricks, week-end specials, ice cream bars, and bulk ice cream. They are good for decorating and do not discolor the cream.

Aufait Ice Cream. Aufait ice cream usually consists of a layer of fruit between two layers of ice cream. The aufait ice cream can be modified by using fruit-flavored gelatin instead of the usual layer of fruit preserves, jams, or candied fruit. The fruit-flavored gelatin has the advantage of being less sweet than the fruit layer which is ordinarily used. This fruit-flavored gelatin should be slightly less firm than the gelatin cubes, and is cut in slabs to form layers in the mold. These slabs are alternated in the mold with layers of ice cream.

Ice cream pies can be modified by using fruit-flavored gelatin instead of the filling of preserved fruits or fruit ice cream which is ordinarily used. The fruit gelatin used in ice cream pies is similar to that used in modified aufait ice cream. The pie crusts are about one-half inch in thickness and may be made by hardening vanilla ice cream between two pie plates. Closed or open pies may be made.

The modified ice cream cake is made by placing alternate layers of ice cream and fruit-flavored gelatin in cake pans. The gel is the same as that used in modified ice cream pies. It is desirable to have the gel filling for ice cream pies and cakes and modified aufait slightly weaker than that used for gelatin cubes. The pies and cakes may be decorated with whipped cream.

Frosted foods, especially frozen fresh fruits and vegetables, offer the possibility of profitable use of refrigeration space and sales effort throughout the year. According to recent figures the use of frosted foods has increased by leaps and bounds. While this industry is in a state of flux, may it not be possible to include some of this business with the ice cream business in such a way as to help the year-round sales?

Frosted Malteds are increasing in popularity during the winter as well as during summer, according to recent reports. In some places the consumption of this product has increased substantially. Frosted Malteds are made of a mix similar to malted milk shakes, and frozen in a freezer as is ice cream. The partially frozen mix is held in the freezer and drawn into cones or paper cups when the customer's order is taken. In consistency it resembles soft ice cream ready to be drawn from the freezer.

Soft ice cream is ice cream marketed directly from the freezer by using any desired mix; or previously hardened ice cream may be softened by spe-

cial process. Proper publicity and attractive advertising of this product should promote further sales along this line, and thus help to bring in additional income to the ice cream manufacturer.

Display Material. The advantage of a proper display of the product and of the advertising material is well known to the manufacturer and also to the dealer and retailer. The retailer generally makes a special effort in displays during the spring and summer, and obtains the beneficial result of increased sales. A similar effort will greatly stimulate winter sales and there is much display material suitable for this purpose. The retailer, like the manufacturer, should make a special effort to keep tuned to all possibilities for stimulating sales throughout the year.

Florists Educated Public. Our friends the florists have done many clever things besides educating the public to "Say it with Flowers." They have educated the American public to associate poinsettias with Christmas, lilies with Easter, shamrocks with St. Patrick's Day, *etc.* They have done all this in spite of the difficulty of getting their flowers to bloom at the exact time desired. The ice cream people of course must do some planning but they do not have to begin preparations so far ahead with so many uncertainties to contend with, as is the case with our friends the florists. They must, however, plan and order needed stock at the proper time so that their specials for certain holidays may be timely and attractive.

The right kind of an advertising man can popularize cherry-nut ice cream for Washington's Birthday. Why couldn't a "victory special" ice cream sell well after the home team has won a big victory or when the results have come out just right for the majority at one of our heated elections? Why not make maple special ice creams in the month of March when maple syrup is fresh and when people are in the mood for it? Some additional possibilities are:

New Year's

Decorated cake featuring the baby New Year, or a bell as part of the decoration, or a brick with a bell center.

Lincoln's Birthday

Decorated cake.

Bust of Lincoln, flag, and other patriotic decorations in individual molds or sliced brick.

Washington's Birthday

Decorated cake.

Hatchet, flag, cherry tree, Washington bust either in cake or individual form.

St. Valentine's Day

Heart and cupid decorations on cake.

Heart center or cupid center bricks and individual molds of same design.

St. Patrick's Day

Shamrock cake or shamrock center brick and countless individual molds, carrying out the shamrock idea.

Easter

Cake decorated with egg or lily.

Individuals in the shape of lilies, eggs, or rabbits.

Individual chickens or chicken center in bricks.

Two-quart standing rabbit, *etc., etc.*

Mother's Day

Whipped cream decorations with "Best Wishes to Mother," "Many Happy Returns," *etc.*

Carnations.

Designs of assorted flowers.

Memorial Day

Special decorated cakes.

Fourth of July

Many individual designs such as flags, shield, cannon, liberty bell, *etc.*

Red, white, and blue bricks.

Special cakes with patriotic decorations.

Hallowe'en

Individual pumpkin, witch, corn cob, black cat, owl designs.

Special decorated cakes with these or combinations for decorations.

Thanksgiving

Special decorated cakes showing turkey, horn of plenty, pumpkin, or other decorations suggestive of Thanksgiving scenes.

Individual designs of numerous kinds along this line may be secured.

Christmas

Special decorated cakes with "Merry Christmas" or other designs that appeal to various groups or nationalities may be used.

Individuals may be made up in the form of a bell, stocking, Christmas tree, Santa Claus, or Christmas tree centers may be featured.

Fall and winter, when the ice cream business is the most sluggish, should be the best time for putting on special campaigns calling attention to ice

cream in connection with the numerous receptions, banquets, and parties all the way from bridge to special social functions.

Dealer Suggestions. First, try some new sundaes with new names and new shapes. For example, why not vary the regular banana split by standing it on its head and by serving it in a tall dish instead of a flat one? Give it a new name that may appeal, say—Banana Skyscraper.

Second, try new flavors. A survey, conducted in 1937 and reported in the January 1938 Ice Cream Trade Journal, indicated that the following flavors proved to be popular among consumers: vanilla, strawberry, chocolate, cherry and variations, orange-pineapple, butter pecan, black walnut, banana and variations, peach, lemon, pineapple, chocolate chip, fruit salad, tutti-fruitti, caramel, peppermint stick, butterscotch, butter crunch, pecan crunch, almond, almond toffee, and pistachio.

Third, try glass containers of neat, modern design in which to serve ice cream. Modern glassware, in contrast to earthenware or china sauce dishes, shows off to better advantage the fine colors of frozen desserts. It gives them "eye appeal." More persistent effort should be made to present ice cream, like other merchandise, in the most attractive package or container available.

Fourth, make use of the best possible technique in the making of ice cream sodas. By so doing you will please and satisfy the most discriminating customer, who quite likely will object to the icy, cloying, or non-palatable concoctions dispensed at some counters.

Fifth, observe careful sanitation. Be proud to have your customers see how clean the ice cream dippers are and how thoroughly all dishes are washed and sanitized in your store. Clean the tops of the fountains and all accessory equipment. There should be plenty of clean towels, sponges, and washing powders on hand. The dispensers themselves, their bodies and hands, should be clean, neat, and trim. Clean uniforms should be provided and worn at all times. An attractive, clean, shining fountain stimulates business. A sloppy-looking place is liable to drive many patrons from the door.

Ice cream manufacturers and dealers should consider themselves fortunate to be connected with a business whose product is liked by nearly everyone and is recognized by nutrition and health experts as an exceptional food.

In conclusion, if more attention is paid to making use of the best available suggestions regarding products, flavors, style, and service, much can be done toward increasing sales and stretching the ice cream season from a few months to all year.

CHAPTER XVII

FORMULAS

It is desirable that the maker of ice cream be well versed in calculating the amounts of the various ingredients needed in the ice cream mix. However, to those new in the business or to the operator who has not mastered the technique of calculating mixes, the following formulas may prove helpful. For convenience, unless otherwise specified, these formulas have been figured on the basis of 5 gallons of mix, and to yield approximately 10 gallons of finished ice cream. In cases where fruits and syrups are added, adjustment must be made for the excess volume of these flavoring materials so as to comply with the prevailing legal standards, and also avoid overloading the freezer. For plain mixes see pp. 181-189.

Vanilla:

From 3 to 6 ounces to flavor 5 gallons of plain mix. The amount to use varies with the strength of the vanilla, quality of the mix, and personal preference.

Coffee:

Five gallons of mix plus one pint of coffee extract. A strong coffee cooked from one pound of ground coffee may be used in place of the coffee extract. A suitable amount of burnt sugar color should be added.

Maple:

Five gallons of mix plus true or imitation maple flavor to suit the taste. A pure maple extract or concentrate is preferable to the use of maple syrup. If maple syrup is used, a special mix containing only 10 to 12 per cent sugar must be used.

Caramel:

Five gallons of mix and enough caramel flavor to impart a satisfactory caramel taste and color. The color should be a deep tan.

Mint:

Five gallons of mix flavored to taste with mint extract. Color light green.

Chocolate:

To 4.5 gallons of mix add chocolate syrup made from 1.5 pounds cocoa (or 2 pounds chocolate liquor), 1.5 pounds sugar, add 2 to 3 quarts of water. Mix the cocoa and sugar together and add enough water to make a paste. Heat in a steam jacketed kettle or double

boiler. As the syrup thickens, add the water gradually, with constant stirring. Heat to 175° F., draw off the syrup, cool, and use. Just enough water to prevent an excessively thick syrup need be used. The syrup can be made up in quantity and stored for a few days in the cold storage room (35° to 40°F.).

Chocolate Malt:

One-half the chocolate syrup used for chocolate ice cream, 1 quart of malt syrup, and 4.5 gallons mix. If malt syrup is not available, use one to two pounds of malted milk.

Mocha:

Same amount of mix and chocolate syrup as for chocolate malt plus 4 to 6 ounces of coffee syrup, or enough to give a mild coffee flavor.

Strawberry:

Use 4.5 gallon mix plus 3 quarts of fresh berries (washed, mixed with one-half their weight of sugar, and held overnight in the cold storage room) or the same amount of frozen (cold pack) berries. Fruit to sugar ratios of 2:1 or 3:1 are best for frozen berries. Color to strawberry pink.

Cherry:

Two to 3 quarts of cherries added to 4.5 gallons of mix at the freezer. Usually maraschino process cherries are used. If processed cherries are not used, it is necessary to select sour cherries and use cherry extract to strengthen the flavor. Color light red.

Raspberry:

Four and one half gallons of mix plus 2 to 3 quarts of raspberries added at the freezer. Since raspberries are very seedy pureed raspberries are frequently used. Addition of true fruit raspberry extract to strengthen the flavor is often practiced. Often a small amount of citric acid is added to bring out the flavor.

Peach:

Four gallons of mix flavored with 1 gallon of sweetened (25 per cent sugar by weight) fresh fruit or pie grade canned peaches. Peach extract is frequently used to fortify the mild fruit flavor. Color light egg yellow.

Pineapple:

Two to 3 quarts of pie grade shredded or crushed pineapple, plus 4.5 gallons mix. Color light yellow.

Banana:

Four pounds of very ripe bananas crushed and mixed with one pound of sugar. Use this with 4.5 gallons of mix. Color light yellow. Often

a small amount of lemon juice or citric acid is added to prevent a slightly flat taste.

Orange:

Use 2 quarts fresh or canned orange juice or the equivalent of orange concentrate (frozen), plus 1 pint of lemon juice; add 1.5 pounds of sugar to the juice. An orange extract is often substituted for a part or all of the juice. Color light orange. Add 4.5 gallons of mix.

Orange Pineapple:

Usually 2 quarts of a prepared flavor is used which consists of crushed pineapple mixed with orange oil or emulsion. Use 4.5 gallons of mix. Color light orange.

Fig:

Add to 4.5 gallons of mix 2 to 3 quarts of canned figs. Color light tan. A good fig-nut ice cream can be made using 2 quarts of canned figs and one pound of chopped nut meats.

Ginger:

To 5 gallons mix add 4 pounds preserved, chopped ginger root. Or add a No. 10 can of ginger root flavoring.

Maple Walnut:

To maple ice cream add 1 to 2 pounds of chopped nut meats at the freezer.

Maple Pecan:

Same as above except use pecan meats.

Butter Pecan:

Add 1.5 pounds of ground butter crunch candy plus 1 pound of chopped pecans to 5 gallons mix.

Burnt Almond:

Five gallons of mix plus 2 pounds burnt or roasted almonds. Almond flavor may also be added, as well as some burnt sugar or caramel color.

Pistachio:

To 5 gallons of mix add 2 pounds of chopped pistachio nut meats, pistachio extract to taste, and color to light green. Frequently English walnuts or pecan nut meats are used instead of pistachio nuts, in which case the pistachio flavor is secured from the extract.

Butter Crunch:

Five gallons of mix plus 3 pounds of ground butter crunch candy.

Butterscotch:

Four and one half gallons of mix and 2 quarts of butterscotch syrup; color to egg yellow.

Peppermint Stick:

Crush or grind through a meat chopper 2 pounds of peppermint stick candy. Use this to flavor 5 gallons of mix.

Peanut Brittle:

Crush or grind 2 to 3 pounds of peanut brittle. Add this at the freezer to 5 gallons of mix.

Bisque:

This is a type of ice cream made by adding a bakery product to the partly frozen mix. To the full 5-gallon mix in the freezer add 2 to 4 pounds of either macaroons, sponge cake, lady fingers, grape nuts, chocolate chips or similiar product, broken in small pieces. The ice cream carries the name of the product used as the flavor.

Tutti-frutti:

To 4.5 gallons of mix add 2 to 4 quarts of a mixture of several fruits. Color to light pink. Usually a prepared fruit mixture is used.

Frozen Pudding:

Usually a prepared mixture is used. However, if nut meats and rum, or rum flavor are added to tutti-frutti ice cream, a frozen pudding flavor is the result.

Nesselrode Pudding:

To 5 gallons of rich mix (similar to parfait mix), add 3 to 4 quarts of a special commercial fruit mixture suitable for Nesselrode Pudding. This should be added after the mix is partly frozen. Or prepare a mixture of the following fruits chopped into small pieces.:

1 pint crushed pineapple (cooked)
1 pint candied cherries
1 pint maraschino cherries
1 pint raisins
6 ounces candied orange peel
1 pound each of walnuts, almonds, and pecans chopped or coarsely ground. Color light orange

Standard plain mix is often used instead of the richer mix in making puddings.

English Plum Pudding:

To 5 gallons parfait mix to which has been added 1½ pounds of chocolate syrup, add the following fruits and nuts after the mix is partly frozen:

1 pound figs
1 pound dates
4 pounds mixed candied fruits
1 pound walnuts
1 pound pecans
3 teaspoons cinnamon
1 teaspoon each of ginger, all-
spice and cloves
4 ounces vanilla extract

Fruits and nuts should be chopped and may be mixed with the spices before they are added to the partly frozen mix, or the spices may be added to the mix before freezing begins.

Parfait:

This requires 4.5 gallons of high-fat (16 per cent) mix and 3.5 dozen fresh eggs. The eggs are added to about a gallon of the mix which is then cooked to a custard (about 160°F. for 30 minutes) and cooled to below 100°F. This custard is then added to the remaining part of the 4.5 gallons of high-fat mix. The resulting 5 gallons of parfait mix can be used like an ordinary ice cream mix to make any flavor desired, as vanilla, chocolate, strawberry, butterscotch and maple nut parfaits, etc.

Aufait:

A molded ice cream and fruit combination consisting of two or more layers of ice cream with pectinized fruit spread between the layers. Strawberry Aufait: Fill a brick mold half full with vanilla ice cream; harden; spread over this a layer of pectinized strawberries (not too thick since it is difficult to cut through the fruit layer when it hardens); harden; and finish filling the mold with vanilla or strawberry ice cream. Many variations both as to number of layers and combinations of fruits are possible.

Aufaits are also made in bulk by gently stirring the pectinized fruit into the ice cream as it comes from the freezer. The fruit should be heavy enough and cold enough so that it will make a more or less continuous line in the ice cream, giving a marbled effect.

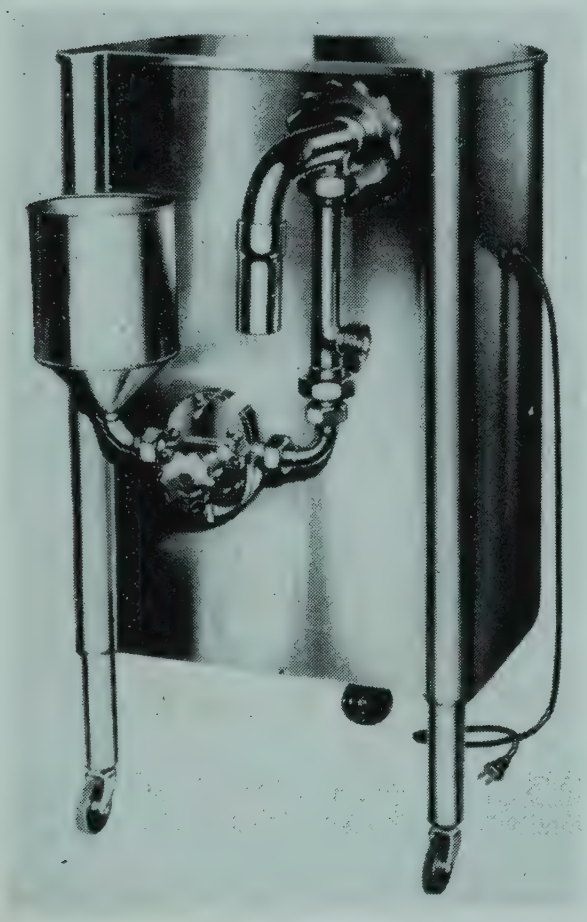
Mousse:

Whip one gallon of 40 per cent cream to a stiff consistency. Gently stir in 2 pounds sugar, a drop or two of desired color, and one-half to one ounce of vanilla. Dates, nuts or fruits free from excessive juice, chopped into rather small pieces, can also be gently stirred in. The mixture is then placed in molds of the desired shape and is frozen

in the hardening room without further agitation. This will yield about two and a half gallons of finished mousse.

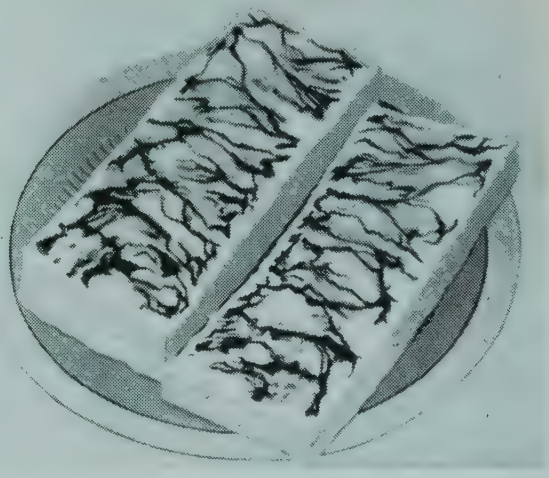
Spumoni:

A special spumoni cup should be used. Press one-fourth of a spumoni cupful of vanilla ice cream around the sides and bottom to line the cup. Add chocolate ice cream to half fill the cup. Finish filling with a mixture of fruit and whipped cream and then place in the hardening room. The fruit and whipped cream mixture is prepared by whipping 1.0 pound confectioner's sugar with 1.0 gallon of heavy cream then gently stirring in the fruit from which excessive juice has been drained.



Courtesy, Bump Pump Company, La Crosse, Wis.

Fig. 37. Bump Flavor Master, a special pump for veining flavors for variegated ice cream, meters the flavor flow to insure uniform dispersion of flavor.



Courtesy, Bump Pump Company

Fig. 38. Showing uniform veining in variegated ice cream.

Rippled Ice Cream:

As the plain vanilla ice cream is drawn from the freezer into the package, specially prepared syrups (such as chocolate, butterscotch, *etc.)* are added by means of a special nozzle so as to produce a marbled effect. Thus a stream of soft ice cream and a stream of the specially prepared syrup enter the package in the desired ratio and are slightly stirred to give a marbled effect. The syrups usually contain about one-half to one per cent stabilizer.

Rainbow Ice Cream:

Carefully mix 6 or more different colored ice creams while they are

soft (as drawn from the freezers) to give a marbled or rainbow colored effect. Then set in the hardening room to harden.

Fruit Salad:

As generally made this consists of fairly large pieces of mixed fruits in combination with whipped cream or ice cream. Pineapple, sliced or cubed; red cherries, apricots, peaches, pears or prunes, properly pitted and sliced, are gently folded into the stiffly whipped cream which has been flavored to taste with a good brand of mayonnaise. This mixture is set to stiffen somewhat before it is placed in molds to harden.

A good formula is about as follows: One gallon fruit mixture to 2/3 gallon whipped cream (mayonnaise-flavored). For variation 2/3 gallon of softened vanilla ice cream may be substituted for the whipped cream.

Sherbet:

Dissolve 11.0 pounds sugar and 4.0 ounces stabilizer in 2.75 gallons water. When cooled below 50°F. add 3.25 quarts of ice cream mix and 1.0 gallon colorless corn syrup. At the freezer add 1.0 gallon of pureed fruit or fruit juices together with the desired amount of color and citric acid solution. When frozen, this mixture will yield about 9 gallons of finished sherbet.

Soufflé:

This product is made from sherbet mixes, except that whole eggs are added and the freezing is done with sufficiently high overrun to give a fluffy product. The following formula is often used: 3½ dozen eggs, 12 pounds sugar, 1 gallon strawberries (frozen pack), about 3 gallons skim milk, or 3 gallons water. By substituting only the fruit used as flavoring many other soufflés can be made.

Lacto:

This product is a milk sherbet made from cultured sour milk, buttermilk, or fermented milk. For grape lacto use 3 gallons cultured sour milk, 9 pounds sugar, 12 eggs, 1½ pints lemon juice, 1 quart grape juice. Dissolve sugar in the milk. Add fruit juices and beaten egg yolks. Whip egg whites and add at the freezer. Other popular flavors can be made by substituting raspberry, cherry, or orange juice for the grape juice.

Water Ice:

Dissolve 8 pounds sugar and 5 ounces stabilizer in 3.5 gallons of water, and then add one gallon of colorless corn syrup. Cool to below 50°F. and add one gallon of pureed fruit or fruit juices together

with the desired amount of color and citric acid solution. When frozen this mixture will yield about 8 gallons.

Granite:

This is made from the same ingredients as an ice but is frozen much harder and with but little whipping or stirring during the freezing process. The result is a coarser textured product than an ice.

Frappé:

Juice of 3 dozen lemons and one dozen oranges, 2 quarts grape juice, 2 pounds sugar, and water enough to make 5 gallons. This is made in the same manner as an ice except that it is not hardened. Since frappés are served in a soft condition they ought preferably to be frozen just prior to serving. Many other fruit mixtures pleasing to taste can easily be developed.

Punch:

An ice in which fruit juices have been reinforced with an alcoholic beverage. Often rum flavoring (non-alcoholic) is used instead of liquor. The following formula is used extensively: To about 7 gallons of water add 20 pounds sugar, 1 quart lemon juice, 1 quart grape juice, and rum flavoring as desired. If it is to be served in frozen form, 5 ounces of stabilizer should be added to the mixture.

Ice Milk:

Thoroughly mix 4 ounces gelatin with 6.75 pounds sugar. While stirring and heating 3.25 gallons of homogenized 4 per cent milk, slowly add the mixed sugar and gelatin. Continue stirring and heating until a temperature of 120°F. has been maintained for 20 minutes. Then cool to about 80°F. and add 12 cans (14 ounces each) of evaporated milk. This will yield 45 pounds of ice milk mix to which any desired color and flavor may be added.

Frosted Malted:

To 3.5 gallons of ice milk mix add 1 quart malt syrup (or 1 to 2 pounds malted milk powder) and chocolate syrup made from 3/4 pound cocoa (or 1 pound chocolate liquor), 3/4 pound sugar and 1 to 1 1/2 quarts water. (Make syrup as directed for Chocolate Ice Cream). Freeze and serve from freezer.

Diabetic Ice Cream:

There is some call for an ice cream low in carbohydrate and sugar content for those who suffer from diabetes. The following formula may help meet this demand: For a 5-gallon mix use 3.25 gallons 30 per cent cream, 1.75 gallons skim milk, 7 fresh eggs, 3.5 ounces gelatin, 3.5 ounces saccharin, 1.75 pounds glycerine. The eggs, gelatin, and saccharin are blended with the milk products, pasteurized

and homogenized in the same manner as in making other ice cream mixes. The 1.75 pounds glycerine is added at the freezer when the desired color and flavor are added. It is imperative that the sugar content of the flavoring be held to the minimum; therefore vanilla, mint, and lemon are most satisfactory. Fruits such as pineapple, peaches, and apricots when well ripened can be used but are less satisfactory in this type of ice cream.

Since the use of saccharin in ice cream is illegal in many states, special permission from health authorities must be secured.

Suggested Formula (using Sorbitol) for Diabetics[1]

For 100 gallons: 400.2 pounds 35 per cent cream; 234.9 pounds 3.5 per cent milk, 139.2 pounds Sorbitol solution (Arlex),[2] 3.5 pounds gelatin (275 bloom), 43.5 pounds whole egg,[3] 48.7 pounds of water, and 43.5 grams saccharin. This ice cream will contain 628 calories per pint at 80 per cent overrun.

Its composition will be as follows: 17 per cent milk fat, 5.1 per cent m.s.n.f., 16.0 per cent Sorbitol solution, 0.4 per cent gelatin, 5.0 per cent liquid whole eggs, 5 grams saccharin per 100 pound mix.

Other Formulas: Many additional colors, flavors, and styles of package are quite suitable for use as frozen desserts. The alert and ingenious ice cream maker, with the aid of his trade association publications and other suggestions picked up from here and there, will be able to develop new flavor combinations and more attractive style of packages. Supply houses are constantly offering new and interesting creations that should help him in increasing his sales and in successfully meeting competition.

FROZEN SUCKER FLAVORS WITH COLOR

Formula for Frozen Sucker Base—Yields 38 Dozen Suckers:

Water	10 gallons
Cane Sugar	15 pounds
Gelatin	5 ounces

Dissolve the sugar in 9½ gallons of water. Do not use heat. Soak gelatin in a small amount of cold water until it swells and becomes soft—then dissolve by stirring and adding sufficient hot water to make one-half gallon of solution. Stir hot gelatin solution into sugar-water mix. Add flavor and acid as recommended below. No color to add. Color present in flavor. Add citric acid solution last. Flavored sucker base should be thoroughly agitated in mixing tank before pouring into the molds. Do not run through freezer.

Standard Acid Solution (50%) for Sherbets, Ices and Frozen Suckers—

[1] Suggested by Dr. P. H. Tracy and George Edman, Department of Food Technology, Univ. of Illinois, in the Ice Cream Trade Journal (July, 1950).

[2] Sorbitol is used as a substitute for sucrose. Its chief value lies in the delay which occurs before the sorbitol appears in the blood as glucose, and its low carbohydrate and insulin values.

[3] Or 12.75 lb. powdered whole eggs plus 30.75 lb. water.

Citric or Tartaric Acid Crystals—4 pounds. Hot water to complete 1.0 gallon finished solution.

Orange: Orange (Natural), 4 to 5 ounces; Citric Acid Solution 50%, 6 to 7 ounces.

Limes: Limes Green (Natural), 4 to 5 ounces; Citric Acid Solution 50%, 14 to 15 ounces.

Grape: Grape Imitation, 4 to 5 ounces; Citric Acid Solution 50%, 8 to 10 ounces.

Raspberry: Raspberry Imitation, 4 to 5 ounces; Citric Acid Solution 50%, 5 to 6 ounces.

Lemon: Lemon Yellow (Natural) 4 to 5 ounces; Citric Acid Solution 50%, 10 to 11 ounces.

Cherry: Cherry Imitation, 4 to 5 ounces; Citric Acid Solution 50%, 6 to 8 ounces.

Pineapple: Pineapple Imitation, 4 to 5 ounces; Citric Acid Solution 50%, 5 to 6 ounces.

Strawberry: Strawberry Imitation, 4 to 5 ounces; Citric Acid Solution 50%, 5 to 6 ounces.

Banana: Banana Imitation, 1 to 2 ounces; Citric Acid Solution 50%, 4 to 5 ounces.

PLAIN MIX FORMULAS

The ice cream maker who, for various reasons, does not care to calculate mixes as previously described, will find that the following formulas in "Mix Formulas" reprinted here by permission of Foote and Jenks, will give quite satisfactory results.

The following eight tables present a great number of mix formulas for the production of ice cream ranging in fat-content from 10% through 18%. Each table gives different combinations of milk products to be used. These are indicated in the heading at the top of the table.

Note that all these formulas are figured on a 100-pound basis which may be easily computed to other amounts.

For example: A batch of 500 gallons of mix is wanted. Multiply the 500 gallons by 9.2 pounds (average weight per gallon of mix) which results in 4600 pounds—the weight of a 500-gallon batch. Then multiply the amount of each ingredient specified in the formula by 46 to obtain the amount required for the batch.

Notice, also, that these mixes are complete except for color and flavor materials. The formulas in the first part of this chapter give the approximate amount of flavoring material to add to the unflavored mix to produce the desired ice cream. Process as described in Chapter XI. "Making and Processing the Mix."

TABLE 19. AMOUNTS OF CREAM OF DIFFERENT FAT CONTENT AND EITHER SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES [a] OF ICE CREAM OF FAIRLY HIGH BUTTERFAT CONTENT WITHOUT THE USE OF CONCENTRATED MILK.

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM				
	[a]Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	6.36	6.27	6.18	6.09	6.00
Sugar	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30
Total solids	35.66	36.57	37.48	38.39	39.30
Water	64.34	63.43	62.52	61.61	60.70

[a] Type refers to the percentage of butterfat in the ice cream.

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM

(Percentage by Weight)

	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	28.00	30.00	32.00	34.00	36.00
Skim milk	56.70	54.70	52.70	50.70	48.70
2) Cream (40% fat)	35.00	37.50	40.00	42.50	45.00
Skim milk	49.70	47.20	44.70	42.20	39.70
3) Cream (30% fat)	46.66	50.00	53.33	56.66	60.00
Skim milk	38.04	34.70	31.37	28.04	24.70
4) Cream (20% fat)	70.00	75.00	80.00	.....	.....
Skim milk	14.70	9.70	4.70	.....	.....
5) Cream (50% fat)	23.46	25.64	27.80	29.91	32.10
Whole milk (3.7% fat)	61.24	59.06	56.90	54.79	52.60
6) Cream (40% fat)	29.92	32.69	35.45	38.18	40.94
Whole milk (3.7% fat)	54.78	52.01	49.25	46.52	43.76
7) Cream (30% fat)	41.29	45.10	48.91	52.67	56.48
Whole milk (3.7% fat)	43.41	39.60	35.79	32.03	28.22
8) Cream (20% fat)	66.61	72.76	78.91	.....	.....
Whole milk (3.7% fat)	18.09	11.94	5.79	.....	.....
Add to any above combination:					
Sugar	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00

TABLE 20. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING DRY SKIM MILK.

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM.

(Percentage by Weight)

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	59.70	58.20	56.70	55.20	53.70	52.20	50.70	49.20	47.70
2) Cream (40% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Skim milk	54.70	52.70	50.70	48.70	46.70	44.70	42.70	40.70	38.70
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	50.00	53.33	56.66	60.00
Skim milk	46.37	43.54	40.70	37.87	35.04	32.20	29.37	26.54	23.70
4) Cream (20% fat)	50.00	55.00	60.00	65.00	70.00	75.00	80.00	.....	.....
Skim milk	29.70	25.20	20.70	16.20	11.70	7.20	2.70	.....	.....
5) Cream (50% fat)	15.21	17.33	19.45	21.57	23.70	25.83	27.96	30.08	32.20
Whole milk (3.7% fat)	64.49	62.87	61.25	59.63	58.00	56.37	54.74	53.12	51.50
6) Cream (40% fat)	19.40	22.10	24.80	27.51	30.22	32.92	35.63	38.34	41.05
Whole milk (3.7% fat)	60.30	58.10	55.90	53.69	51.48	49.28	47.07	44.86	42.65
7) Cream (30% fat)	26.76	30.50	34.25	37.98	41.70	45.43	49.17	52.90	56.63
Whole milk (3.7% fat)	52.94	49.70	46.45	43.22	40.00	36.77	33.53	30.30	27.07
8) Cream (20% fat)	43.17	49.20	55.22	61.25	67.27	73.30	79.32	.....	.....
Whole milk (3.7% fat)	36.53	31.00	25.48	19.95	14.43	8.90	3.38	.....	.....
Add to any above combination:									
Dry skim milk*	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* 95 percent solids.

TABLE 21. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING UNSWEETENED CONDENSED SKIM MILK.

Ingredients	Percentage of Ingredients in Various Types of Ice Cream								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM.

(Percentage by Weight)

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	41.00	41.25	41.50	41.80	42.10	42.40	42.70	42.95	43.19
2) Cream (40% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Skim milk	36.00	35.75	35.50	35.30	35.10	34.90	34.70	34.45	34.19
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	49.99	53.33	56.66	60.00
Skim milk	27.67	26.59	25.50	24.47	23.44	22.41	21.37	20.29	19.19
4) Cream (20% fat)	50.00	55.00	60.00	65.00	70.00	.....	.....	.....	.....
Skim milk	11.00	8.25	5.50	2.80	0.10	.....	.....	.....	.....
5) Cream (50% fat)	16.73	18.70	20.68	22.66	24.63	26.61	28.59	30.57	32.53
Whole milk (3.7% fat)	44.27	44.55	44.82	45.14	45.47	45.79	46.11	46.38	46.66
6) Cream (40% fat)	21.33	23.85	26.37	28.89	31.41	33.93	36.45	38.97	41.50
Whole milk (3.7% fat)	39.67	39.40	39.13	38.91	38.69	38.47	38.25	37.98	37.69
7) Cream (30% fat)	29.44	32.92	36.40	39.82	43.35	46.82	50.30	53.77	57.25
Whole milk (3.7% fat)	31.56	30.33	29.10	27.98	26.75	25.58	24.40	23.18	21.94
8) Cream (20% fat)	47.49	53.10	58.72	64.32	69.92	.....	.....	.....	.....
Whole milk (3.7% fat)	13.51	10.15	6.78	3.48	0.18	.....	.....	.....	.....
Add to any above combination: Unsw. condensed skim milk*	23.70	21.45	19.20	16.90	14.60	12.30	10.00	7.75	5.51
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Concentration 3 to 1; contains 27 percent milk-solids-not-fat.

TABLE 22. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING SWEETENED CONDENSED SKIM MILK

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM.

(Percentage by Weight)

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	54.74	53.63	52.68	51.59	50.56	49.53	48.49	47.45	46.40
2) Cream (40% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Skim milk	49.74	48.18	46.63	45.09	43.56	42.03	40.49	38.95	37.40
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	49.99	53.33	56.66	60.00
Skim milk	41.41	39.02	36.63	34.26	31.90	29.54	27.16	24.79	22.40
4) Cream (20% fat)	50.00	55.00	60.00	65.00	70.00	.....	.....	.....	.....
Skim milk	24.74	20.68	16.63	12.59	8.56	.....	.....	.....	.....
5) Cream (50% fat)	15.63	17.71	19.79	21.87	23.96	26.04	28.13	30.21	32.30
Whole milk (3.7% fat)	59.11	57.97	56.84	55.72	54.60	53.49	52.36	51.24	50.10
6) Cream (40% fat)	19.93	22.58	25.24	27.89	30.55	33.20	35.86	38.53	41.20
Whole milk (3.7% fat)	54.81	53.10	51.39	49.70	48.01	46.33	44.63	42.92	41.20
7) Cream (30% fat)	27.51	31.17	34.83	38.49	42.16	45.82	49.49	53.13	56.80
Whole milk (3.7% fat)	47.23	44.51	41.80	39.10	36.40	33.71	31.00	28.32	25.60
8) Cream (20% fat)	44.69	50.44	56.19	62.10	68.00	73.91	79.83	.....	.....
Whole milk (3.7% fat)	30.05	25.24	20.44	15.49	10.56	5.62	0.66	.....	.....
Add to any above combination: Sw. condensed skim milk*	17.22	15.57	13.92	12.27	10.61	8.96	7.31	5.65	4.00
Sugar	7.74	8.45	9.15	9.84	10.53	11.21	11.90	12.60	13.30
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Contains 30.0 percent milk-solids-not-fat, 42 percent sugar, 28 percent water

TABLE 23. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING UNSWEETENED CONDENSED SKIM MILK AND LIQUID SUGAR.

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM.

(Percentage by Weight)

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	30.42	30.70	30.99	31.29	31.59	31.86	32.14	32.39	32.65
2) Cream (40% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Skim milk	25.42	25.20	24.99	24.79	24.59	24.36	24.14	23.89	23.65
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	49.99	53.33	56.66	60.00
Skim milk	17.09	16.04	14.99	13.96	12.93	11.87	10.81	9.73	8.65
4) Cream (20% fat)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skim milk	.....	.....	.....	.....	.....	.....	.....	.....	.....
5) Cream (50% fat)	17.61	19.57	21.54	23.51	25.48	27.47	29.46	31.43	33.40
Whole milk (3.7% fat)	32.81	33.13	33.45	33.78	34.11	34.39	34.68	34.96	35.25
6) Cream (40% fat)	22.42	24.95	27.49	30.03	32.57	35.08	37.59	40.16	42.74
Whole milk (3.7% fat)	28.00	27.75	27.50	27.26	27.02	26.78	26.55	26.23	25.91
7) Cream (30% fat)	30.90	34.39	37.88	41.25	44.62	48.20	51.78	55.34	58.90
Whole milk (3.7% fat)	19.52	18.31	17.11	16.04	14.97	13.66	12.36	11.05	9.75
8) Cream (20% fat)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Whole milk (3.7% fat)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Add to any above combination: Unsw. condensed skim milk*	27.28	25.00	22.71	20.41	18.11	15.84	13.56	11.31	9.05
Liquid sugar**	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Concentration 3 to 1; contains 27 percent milk-solids-not-fat.
** 68.1 percent concentration; *i.e.*, 1 gallon=11 pounds containing 7.5 pound sugar.

TABLE 24. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING SWEETENED CONDENSED SKIM MILK AND LIQUID SUGAR.

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM.

(Percentage by Weight)

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	50.65	49.25	47.86	46.44	45.02	43.59	42.16	40.82	39.48
2) Cream (40% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Skim milk	45.65	43.75	41.86	39.94	38.02	36.09	34.16	32.32.	30.48
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	50.00	53.33	56.66	60.00
Skim milk	37.32	34.59	31.86	29.11	26.36	23.59	20.83	18.16	15.48
4) Cream (20% fat)	50.00	55.00	60.00	65.00	70.00	.....	.....	.....	.....
Skim milk	20.65	16.25	11.86	7.44	3.02	.....	.....	.....	.....
5) Cream (50% fat)	15.95	18.07	20.19	22.28	24.37	26.49	28.62	30.75	32.89
Whole milk (3.7% fat)	54.70	53.18	51.67	50.16	48.65	47.10	45.54	44.07	42.59
6) Cream (40% fat)	20.32	23.01	25.70	28.39	31.09	33.79	36.50	39.17	41.84
Whole milk (3.7% fat)	59.33	48.24	46.16	44.05	41.93	39.80	37.66	35.65	33.64
7) Cream (30% fat)	28.11	31.81	35.51	39.19	42.87	46.63	50.39	54.10	57.81
Whole milk (3.7% fat)	42.54	39.44	36.35	33.25	30.15	26.96	23.77	20.72	17.67
8) Cream (20% fat)	46.24	51.81	57.38	63.25	69.13	.....	.....	.....	.....
Whole milk (3.7% fat)	24.41	19.44	14.48	9.19	3.89	.....	.....	.....	.....
Add to any above combination: Sw. condensed skim milk*	18.43	16.88	15.32	13.76	12.21	10.67	9.14	7.53	5.93
Liquid sugar**	10.62	11.57	12.52	13.50	14.47	15.44	16.40	17.35	18.29
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Contains 30.0 percent milk-solids-not-fat, 42 per cent sugar, 28 percent water.

** 68.1 percent concentration; *i.e.*, 1 gallon = 11 pounds containing 7.5 pounds sugar.

TABLE 25. AMOUNTS OF CREAM WITH 50 PER CENT OF THE FAT ADDED IN THE FORM OF BUTTER, UNSWEETENED CONDENSED OR DRY SKIM MILK, AND WATER OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM

Ingredients	Percentage of Ingredients in Various Types of Ice Cream								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	36.30	36.80	37.30	37.80	38.30	38.80	39.30	39.80	40.30
Water	63.70	63.20	62.70	62.20	61.70	61.20	60.70	60.20	59.70

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM. *(Percentage by Weight)*

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (40% fat)	12.50	13.75	15.00	16.25	17.50	18.75	20.00	20.25	22.50
Unsw. con. sk. mlk.*	24.40	22.30	20.20	17.90	15.60	13.40	11.20	8.97	6.75
Water	41.70	41.95	42.20	42.65	43.10	43.42	43.75	44.10	44.45
2) Cream (40% fat)	12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50
Dry skim milk**	5.00	4.55	4.10	3.65	3.20	2.75	2.30	1.85	1.40
Water	61.10	59.70	58.30	56.90	55.50	54.07	52.65	51.22	49.80
3) Cream (20% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Unsw. con. sk. mlk.*	24.40	22.30	20.20	17.90	15.60	13.40	11.20	8.97	6.75
Water	29.20	28.20	27.20	26.40	25.60	24.67	23.75	22.85	21.95
4) Cream (20% fat)	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
Dry skim milk**	5.00	4.55	4.10	3.65	3.20	2.75	2.30	1.85	1.40
Water	48.60	45.95	43.30	40.65	38.00	35.32	32.65	29.97	27.30
5) Cream (40% fat)	8.25	9.47	10.70	11.85	13.00	14.30	15.60	16.90	18.20
Unsw. con. sk. mlk.*	24.40	22.30	20.20	17.90	15.60	13.40	11.20	8.97	6.75
Wh. mk. (3.7% fat)	45.95	46.23	46.50	47.05	47.60	47.87	48.15	48.45	45.75
6) Cream (40% fat)	6.23	7.65	9.08	10.44	11.80	13.15	14.50	15.80	17.10
Dry skim milk**	5.00	4.55	4.10	3.65	3.20	2.75	2.30	1.85	1.40
Wh. mk. (3.7% fat)	67.37	65.80	64.22	62.71	61.20	59.67	58.15	56.67	55.20
7) Cream (20% fat)	18.50	21.20	23.90	26.55	29.20	32.00	34.80	37.40	40.00
Unsw. con. sk. mlk.*	24.40	22.30	20.20	17.90	15.60	13.40	11.20	8.97	6.75
Wh. mk. (3.7% fat)	35.70	34.50	33.30	32.35	31.40	30.17	28.95	27.95	26.95
8) Cream (20% fat)	14.10	17.10	20.10	23.10	26.10	29.10	32.10	35.15	38.20
Dry skim milk**	5.00	4.55	4.10	3.65	3.20	2.75	2.30	1.85	1.40
Wh. mk. (3.7% fat)	59.50	53.35	53.20	50.05	46.90	43.72	40.55	37.32	34.10
Add to any above combination:									
Butter***	6.10	6.70	7.30	7.90	8.50	9.13	9.75	10.38	11.00
Sugar	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* 27 percent milk-solids-not-fat. ** 95 percent solids. *** 82 percent butterfat.

TABLE 26. AMOUNTS OF CREAM OF VARIOUS FAT CONTENT AND SKIM OR WHOLE MILK NECESSARY FOR MAKING DIFFERENT TYPES OF ICE CREAM USING UNSWEETENED CONDENSED SKIM MILK AND UP TO HALF THE NORMAL SUCROSE REPLACED BY CORN SYRUP WHILE MAINTAINING A SWEETNESS OF 13.5*

Ingredients	PERCENTAGE OF INGREDIENTS IN VARIOUS TYPES OF ICE CREAM								
	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fat	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
Milk-solids-not-fat	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
Sucrose	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Corn syrup solids	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total solids	38.80	39.30	39.80	40.30	40.80	41.30	41.80	42.30	42.80
Water	61.20	60.70	60.20	59.70	59.20	58.70	58.20	57.70	57.20

EIGHT POSSIBLE COMBINATIONS OF MILK PRODUCTS AND OTHER INGREDIENTS FOR EACH TYPE OF ICE CREAM. *(Percentage by Weight)*

	Type 10	Type 11	Type 12	Type 13	Type 14	Type 15	Type 16	Type 17	Type 18
1) Cream (50% fat)	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00
Skim milk	33.42	33.71	34.00	34.27	34.55	34.83	35.11	35.41	35.70
2) Cream (40% fat)	25.00	27.50	30.00	32.00	35.00	37.50	40.00	42.50	45.00
Skim milk	28.42	28.21	28.00	27.77	27.55	27.33	27.11	26.91	26.70
3) Cream (30% fat)	33.33	36.66	40.00	43.33	46.66	49.99	53.33	56.66	60.00
Skim milk	20.09	19.05	18.00	16.94	15.89	14.84	13.78	12.75	11.70
4) Cream (20% fat)	50.00	.....	.....	.....	.....	.....	.....	.....	.....
Skim milk	3.42	.....	.....	.....	.....	.....	.....	.....	.....
5) Cream (50% fat)	17.28	19.26	21.24	23.21	25.19	27.17	29.15	31.13	33.11
Wh. mk. (3.7% fat)	36.14	36.45	36.76	37.06	37.36	37.66	37.96	38.28	38.59
6) Cream (40% fat)	22.11	24.63	27.16	29.68	32.20	34.71	37.22	39.74	42.26
Wh. mk. (3.7% fat)	31.31	31.08	30.84	30.59	30.35	30.12	29.89	29.67	29.44
7) Cream (30% fat)	30.50	34.03	37.56	40.99	44.43	47.90	51.37	54.84	58.31
Wh. mk. (3.7% fat)	22.92	21.68	20.44	19.28	18.12	16.93	15.74	14.57	13.39
8) Cream (20% fat)	49.21	.....	.....	.....	.....	.....	.....	.....	.....
Wh. mk. (3.7% fat)	4.21	.....	.....	.....	.....	.....	.....	.....	.....
Add to any above combination:									
Unsw. cond. skim milk**	26.28	23.99	21.70	19.43	17.15	14.87	12.59	10.29	8.00
Sucrose	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Corn syrup***	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Stabilizer	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* The amount of sugar used is calculated to be that amount which will make the finished mix as sweet as one containing 13.5 percent sucrose.

** Concentration 3 to 1; contains 27% milk-solids-not-fat.

*** Corn syrup containing 80.3% solids. High equivalent syrup of 82% solids of greater sweetness can be used in compounding these mixes by adding from 3 to 6 lbs. of water to 100 lbs. of syrup.

"SOFT" ICE CREAM — SPECIAL FORMULA

At present there is a marked demand for this new form of ice cream which has generally come to be known as "soft" ice cream. Perhaps this term has been applied to it largely because it is marketed in soft form and for consumption shortly after it is drawn from the freezer. The fact that it is marketed under these conditions makes it possible to use a formula with a considerably larger quantity of serum solids than is found in the usual formulas.

"Soft" Ice Cream—Formula A

A good formula for soft ice cream would be about as follows:

Ingredients for 100 lb. mix	percentage composition
0.30 lb. Shervel (Stab.) or gelatin	12% fat
13.00 lb. sugar	14% s.s.
8.27 lb. skipo	13% sufect
24.62 lb. cream (40% fat)	0.3% stab.
53.81 lb. milk (4% fat)	39.3% t.s.
Any desired flavoring can be used.	

The mix weight is 9.17 pounds per gallon. A desirable finished product will have approximately 100% overrun and will weigh 4.6 pounds per gallon.

Note the difference in serum solids in this special formula as compared with that of a good average standard formula such as is suitable for ordinary hard Ice Cream where one has to guard against lactose crystalization—the usual cause of "sandy" ice cream.

Standard Ice Cream—Formula B

Ingredients for 100 lb. mix	percentage composition
0.30 lb. Dariloid or gelatin	12% fat
4.00 lb. Frodex	11% s.s.
12.12 lb. sugar.	14% sufect
5.18 lb. skipo	0.3% stab.
24.61 lb. cream (40% fat)	39.3% t.s.
53.79 lb. milk (4% fat)	

The mix weight is 9.17 pounds per gallon, and when frozen with 100% overrun the finished ice cream will weigh 4.6 pounds per gallon as in the case of Formula A.

FORMULAS FOR ICE MILK MIX

In recent years Ice Cream Makers have been confronted with steadily mounting production costs. This situation has meant increased costs to consumers or lowering production costs. Those who believe that constantly

increasing costs, particularly on children's items, are not the right answer have turned to lower cost formulas for soft ice milk, candy covered bars (sticks), novelties, *etc.*, as a better answer.

Ice milks are frequently used in chocolate or other candy coated and novelty forms. The popular soft ice milks are marketed for immediate consumption, in cones and other kinds of packages. Where ice milks are to be used for hardened products such as the candy coated, various stick products, *etc., etc.,* the following formulas are typical:

Formula C for hardened products

Ingredients for 100 lb. mix	**percentage composition**
0.50 lb. Dariloid (stab.) or gelatin	4% fat
15.00 lb. sugar	11% s.s.
4.26 lb. skipo (skim powder)	15% sufect (sugar)
2.24 lb. cream (40% fat)	0.5% stab.
78.00 lb. milk (4% fat)	30.5% t.s.

The mix weight is 9.20 pounds per gallon. A desirable finished product will have approximately 53% overrun, and will weigh 6.0 pounds per gallon.

Formula D for hardened products

Ingredients for 100 lb. mix	**percentage composition**
0.40 lb. Dariloid or gelatin	4% fat
10.64 lb. Frodex	11% s.s.
10.00 lb. cane sugar	15% sufect
4.84 lb. skipo	0.4% stab.
2.88 lb. cream (40% fat)	35.7% t.s.
71.24 lb. milk (4% fat)	

The mix weight is 9.40 pounds per gallon. A desirable finished product will have approximately 80% overrun, and will weigh 5.2 pounds per gallon.

Formula E for hardened products

Ingredients for 100 lb. mix	**percentage composition**
0.50 lb. Gelox (Stab.)	6% fat
15.00 lb. cane sugar	12% s.s.
5.61 lb. skim powder	15% sufect
8.50 lb. cream (40% fat)	0.5% stab.
70.39 lb. milk (3.7% fat)	33.5% t.s.

The mix weight is 9.22 pounds per gallon. A desirable finished product will have approximately 63% overrun, and will weigh 5.6 pounds per gallon.

For soft ice milk marketed directly from the freezer and for immediate consumption, the following formulas are typical and quite satisfactory.

Formula F for soft products

Ingredients for 100 lb. mix	percentage composition
0.30 lb. Shervel (Stab.)	4% fat
8.00 lb. Frodex	16% s.s.
11.24 lb. cane sugar	15% sufect
10.36 lb. skipo	0.3% stab.
3.33 lb. cream (40% fat)	39.3% t.s.
66.77 lb. milk (4% fat)	

The mix weight is 9.54 pounds per gallon. A desirable finished product will have approximately 98% overrun, and will weigh 4.8 pounds per gallon.

Formula G for soft products

Ingredients for 100 lb. mix	percentage composition
34.00 lb. plain ice cream mix (12% fat., 10% s.s., 15% sufect, 0.3% stab.)	4% fat
	16% s.s.
	15% sufect
0.22 lb. gelatin	0.3% stab.
10.00 lb. Frodex	40.3% t.s.
5.20 lb. cane sugar	
13.00 lb. skipo	
37.88 lb. water	

The mix weight is 9.58 pounds per gallon. A desirable finished product will have approximately 100% overrun, and will weigh 4.7 pounds per gallon.

Formula H for soft products

Ingredients for 100 lb. mix	percentage composition
0.40 lb. Gelox (Stab.)	6% fat
10.00 lb. Dri-Sweet	12% s.s.
10.30 lb. cane sugar	15% sufect
6.13 lb. skim powder	0.4% stab.
9.10 lb. cream (40% fat)	38.3% t.s.
64.07 lb. milk (3.7% fat)	

The mix weight is 9.40 pounds per gallon. A desirable finished product will have approximately 90% overrun, and will weigh 4.9 pounds per gallon.

Formula I for soft products

Ingredients for 100 lb. mix	percentage composition
0.30 lb. Gelox (Stab.)	6% fat
7.00 lb. Dri-Sweet	14% s.s.
11.71 lb. cane sugar	15% sufect

8.24 lb. skim powder	0.3% stab.
9.12 lb. cream (40% fat)	38.73% t.s.
63.63 lb. milk (3.7% fat)	

The mix weight is 9.41 pounds per gallon. A desirable finished product will have approximately 90% overrun, and will weigh 4.9 pounds per gallon.

Formula J for soft products

Ingredients for 100 lb. mix	**percentage composition**
0.30 lb. Gelox (Stab.)	6% fat
10.00 lb. Dri-Sweet	14% s.s.
10.30 lb. cane sugar	15% sufect
8.40 lb. skim powder	0.3% stab.
9.30 lb. cream (40% fat)	40.2% t.s.
61.70 lb. milk (3.7% fat)	

The mix weight is 9.48 pounds per gallon. A desirable finished product will have approximately 100% overrun, and will weigh 4.7 pounds per gallon.

CHAPTER XVIII

DEFECTS, SCORING AND GRADING

Quality and price are two major factors in determining not only the volume of current business but also the future of the entire ice cream industry. Since quality is so vital in establishing price, it is necessary to understand the cause and remedy of defects in quality. The manufacturer and connoisseur both realize that defects in quality are the result of faults in flavor, body and texture, melting characteristics, color and package, bacterial content, or composition. In their effort to improve the quality they assume an ideal of perfection for each of these characteristics. This ideal standard is embodied in a score card which is used to measure the degree of perfection, and the deductions which should be made for the various defects of the ice cream.

The scoring of ice creams and ices presents some difficulties which are not encountered in scoring other dairy products. In the first place, the ideal flavor is far more variable than the ideal flavor for other dairy products, since it depends not only on the flavoring material used but also on the presence of other substances which blend with and modify the added flavoring material. Such a blend or combination, even if it be unintentional, is not always displeasing. Consequently, the ideal standard is a blend of two ideal flavors: the ideal flavor in the dairy products and the ideal flavor in the added flavoring material.

FLAVOR DEFECTS

The qualities of flavor imparted by the flavoring material may be designated as high, low, delicate, harsh, and unnatural.

High flavor is characterized by the presence of large amounts of the flavoring material. In some cases an excess of flavoring material will impart a sharp or bitter flavor to the ice cream. A poor quality of flavoring may have the same effect; hence, it is quite important to determine, if possible, whether the bitter flavor is due to poor quality or to large amounts of flavoring material, although both are undesirable defects.

Low flavor refers to an insufficient amount of flavoring material; that is, not enough to make the flavor easily recognized. It may be due to insufficient or weak flavoring material, to some other substance obscuring the flavor, or to the ice cream mix being cooked after the volatile flavoring material is added. However, low flavor should not be confounded with delicate flavor.

Delicate flavors are, as a rule, the most pleasing and desirable and most easily blended, and they do not readily clog the appetite. Natural flavors,

such as fruit and nut flavors, are delicate and pleasing to taste but they are also readily dissipated by careless handling.

Harsh flavors are sharp and lingering, such as ginger, onion, and vinegar. A good illustration of this defect in ice cream is obtained when quite large quantities of lemon or orange extract are used, giving a flavor entirely due to the lemon or orange oil. Harsh flavors are usually due to the use of inferior flavoring substances, but may in some cases result from the use of too much flavoring extract. Inferior and artificial extracts lack the fine, delicate qualities of the high grade extracts and frequently give a very pronounced, but not pleasing, flavor to the ice cream.

Unnatural flavors are considered as defects, but the extent to which the score is reduced will depend upon the source of that flavor. For example, because of its acidity lemon juice is sometimes added to reinforce certain fruit flavors. However, should any of the oil from the rind of the lemon find access to the mixture, it is likely to impart a lemon flavor where it is not wanted. In such a case, the resulting blended fruit flavor would be "unnatural" but not of a particularly undesirable sort. Similarly, a pronounced coumarin flavor in vanilla ice cream, caramel flavor in maple ice cream colored with caramel, and synthetic flavors that are not perfect imitations of the true flavors are considered unnatural. Flavors due to poor cream, poor gelatin, fermented syrups, overripe or unsound fruit, and rancid nuts are unnatural flavors to which a lower score should be given.

Fruit and fruit juices may impart undesirable flavors if the fruit is unsound or the juice fermented. The naturally delicate flavor imparted by sound fruit may be quite easily distinguished from the artificial flavors. An artificial flavor, being somewhat unnatural, is not entitled to as high a score as a natural flavor.

Nut flavors are to be judged in the same way as fruit flavors. The way in which the nuts have been prepared should also receive attention. It should be noted whether or not the nuts have been blanched, finely chopped, and evenly distributed through the ice cream.

Syrups and sugar may be used in excess, making the mixture too sweet. When an insufficient amount is used the ice cream has a flat flavor. Sometimes a sour or yeasty flavor may be imparted by the use of a syrup which has begun to ferment.

The flavors imparted by the dairy products are the most important from an hygienic standpoint. The flavor given to ice cream by good, pure dairy products is rich, creamy, and delicate. Flavor defects usually described as "cooked" and "feed" (when due to normal feeds) are not of a particularly undesirable sort. Lower scores should be given for flavors due to the use of

tainted dairy products. These flavors may be grouped under such terms as "feed" (due to weeds, *etc.*), "high acid," "neutralizer," "old ingredient" such as yeasty, cheesy, musty, bitter, *etc.*, "oxidized," "rancid," "salty" (when due to "salty" cream), and "unclean" (suggestive of limburger cheese or the odor of dirty washing solution).

Defects caused by chemical changes. Flavor defects described as "storage" (stale) and "oxidized" (resembling cardboard or tallow) sometimes develop in ice cream as the result of chemical changes and are particularly objectionable. An especially unpleasant flavor, suggesting a stale and unclean flavor, may be absorbed from the air of the hardening room when moisture-soaked wood is exposed through lack of paint or cracked paint. This absorbed flavor defect is usually most noticeable in the whipped cream decorations of specialties being hardened without wrapping.

BODY DEFECTS

Body may be said to be that quality which gives weight and substance to the product and enables it to stand up well. Thus it refers to consistency ("chewiness") or firmness and to the melting character of ice cream. The ideal body is that which is produced by the correct proportion of milk solids (both butterfat and serum solids) together with the proper overrun, and which melts fairly rapidly at room temperature to a smooth liquid similar in appearance and consistency to sweet cream containing about 40 per cent fat. It results from the proper combination of composition and method of processing, each being somewhat limited by the other.

A "crumbly" body lacks cohesion and pulls or breaks apart very easily—a common defect of sherbets and ices where it is less serious than in ice cream. It is frequently associated with a low total solids content, insufficient stabilization, excessive overrun, low homogenization pressure, large air cells, and imperfect homogenization. Factors (such as improper salt balance, enzymatic improvers, and certain gum stabilizers) which limit the hydration of the proteins are thought to cause "crumbliness." It is similar to the defect sometimes referred to as "dry" body which results from excessive use of emulsifiers, egg yolk solids, certain types of vegetable stabilizers, excessive homogenization pressure, or the addition of dry milk solids at the freezer.

A "soggy" body is dense and may be somewhat "wet" in appearance. In some market areas this defect is not too objectionable. It is due to a low overrun (especially if the total solids content is high), a high concentration of sugars that lower the freezing point, hand packaging after hardening the ice cream, or excessive concentration of gelatin. It is frequently confused with defects described as "gummy," "doughy," "sticky," and "gluey." Excessive stabilization or a high total solids content produces a "chewy" or

"gummy" body while syrups and certain types of gum (pectin, oatgum, *etc.*) favor a "pasty," "sticky," or "gluey" body. Sogginess and its related defects contribute to high melting resistance.

A "weak" body lacks firmness or "chewiness" and is invariably accompanied by rapid melting. It should not be confounded with "fluffy" or "snowy" texture and excessive overrun. A weak body is particularly undesirable from the consumer's viewpoint and should receive a very low score. The defect is due to a low total solids content combined with insufficient stabilization, and therefore a thin mix—a mix which lacks consistency.

MELTING CHARACTERISTICS

The melting appearance of ice cream is sometimes distinctly foamy. This should be considered a defect and is due particularly to large air cells and large amounts of egg solids. Emulsifiers or excess gelatin in low solids mixes, as well as a heavy mix consistency, are likely to augment the condition.

"Curdy" melt down includes not only the finely divided particles of protein in watery liquid, but also a dull, finely wrinkled, scum-like surface on the melted ice cream. This defect leads the consumer to assume that inferior ingredients were used. Actually it is the result of protein destabilization which may be caused by any one or any combination of the following: excess acidity, low concentration of citrates and phosphates in proportion to the calcium and magnesium content, melting and refreezing even in the freezer, the use of enzymatic improvers, the use of certain stabilizers, excessive homogenization pressures, long storage at low temperatures, and shrinkage of the ice cream.

"Does not melt" includes not only the ice cream which retains its shape when warmed but also the various degrees of slow melting to a liquid. It frequently accompanies body defects described as "soggy," "gummy," "doughy," and "sticky." The conditions causing these body defects also contribute to high melting resistance. Other factors producing this melting defect include a high fat content, drawing at a low temperature from continuous freezers, a high freezing point, and excessive viscosity resulting from slow cooling, the use of calcium neutralizers, or certain types of stabilizer.

TEXTURE DEFECTS

Texture refers to the grain or to the finer structure of the product, and depends upon the size, shape, and arrangement of the small particles. Ice cream having an ideal texture will be very smooth, the solid particles being too small to be detected in the mouth.

"Buttery" texture refers to lumps of butterfat large enough to be easily detected in the mouth. When a lump of butterfat is chewed, the sensation is

different from that obtained from ice crystals or from lactose crystals. This defect is due to churning (usually during the freezing process), which results from incomplete homogenization, high fat content, mix entering the freezer at too high a temperature, and slow freezing.

"Coarse" or icy texture indicates that the ice crystals are large or not uniform in size, or that the air cells are too large. The coarseness due to large air cells should not be confused with high overrun obtained by small air cells. This is the most common texture defect and is affected by many factors. For example, large air cells may be due to the type of freezer used, or to a mix of low whipping ability. Large ice crystals are favored by (1) insufficient stabilizer, (2) slow freezing in the freezer, (3) slow freezing in the hardening room (such as happens after partial melting before entering, and refreezing in the hardening room or when storage temperatures fluctuate and slightly softened ice cream is re-hardened), and (4) insufficient hydration of the protein (lack of aging, high acidity, poor salt balance, *etc.*). The defect "coarse and icy" also includes the presence of ice pellets which should receive a low score. These pellets are caused by droplets of water getting into the ice cream, frequently from the retailer's scoops.

"Fluffy" texture is readily detected by the large air cells and open texture. It is due to the incorporation of an excessive amount of air either as large or small air cells. This defect may be expected when the total solids content is not more than one-third of the overrun. When the air cells are large and the amount of air is excessive the texture is sometimes described as "snowy" or "flaky." Such a condition might be more properly scored as both "fluffy" and "coarse."

"Sandy" texture is readily detected by a roughness like sand in melted ice cream not only when rubbed against the roof of the mouth but also when chewed. Sandy texture should receive a very low score since it jeopardizes the marketability of the ice cream. It is due entirely to fairly large lactose crystals which are slow to dissolve. Conditions favoring the development of a sandy texture include a high lactose content (usually expressed as high serum solids content), high and perhaps fluctuating temperatures (as in retail cabinets), or high temperature when drawn from freezer, low viscosity of the unfrozen liquid phase, and perhaps the presence of subtances which initiate crystal formation.

COLOR AND PACKAGE DEFECTS

Color and package aid in presenting the tempting appearance essential in a food or dessert. Therefore, good workmanship as evidenced by delicate, appropriate colors, uniformity of colors, not only the uniformity of layers but also the clearness of object outlines in molded ice creams, and

the cleanliness and neatness of packages should receive consideration. The ideal color is characteristic of the flavor, true in shade, and neither too pale nor too intense. For example, vanilla ice cream should be the color of cream produced on early pasture.

"Unnatural" color describes defects due to insufficient (pale) color, excess (intense) color, and colors that are not characteristic (true in shade) of the flavor. Examples of defective shades are the tannish brown of caramel instead of the reddish brown of chocolate, or egg yellow for annatto color in vanilla ice cream, or a dull, grayish appearance (due to neutralization of the mix) in vanilla ice cream, and a slight bluish tint (due to lack of acidity) in cranberry ice cream.

Other defects such as uneven color, no parchment, rusty cans, and unclean cans are too obvious to need discussion here.

COMPOSITION AND BACTERIAL DEFECTS

Standards for composition and bacterial content are now adopted by nearly all communities, so that the public may be assured of a safe, healthful product. These standards represent the lowest quality (*i.e.,* the least expensive) permissible for market, and should not be interpreted as either optimum or ideal quality. As yet there is no widely accepted procedure for scoring variations in either bacterial content or composition except to require compliance with local legal standards.

"Sediment" designates insoluble foreign material such as dust, hay, hair, buttons, and hairpins. It proves extreme carelessness and therefore is extremely objectionable. It may enter as part of the ingredients, when the ingredients are carelessly produced or stored (as in open containers,) or it may be due to carelessness while manufacturing.

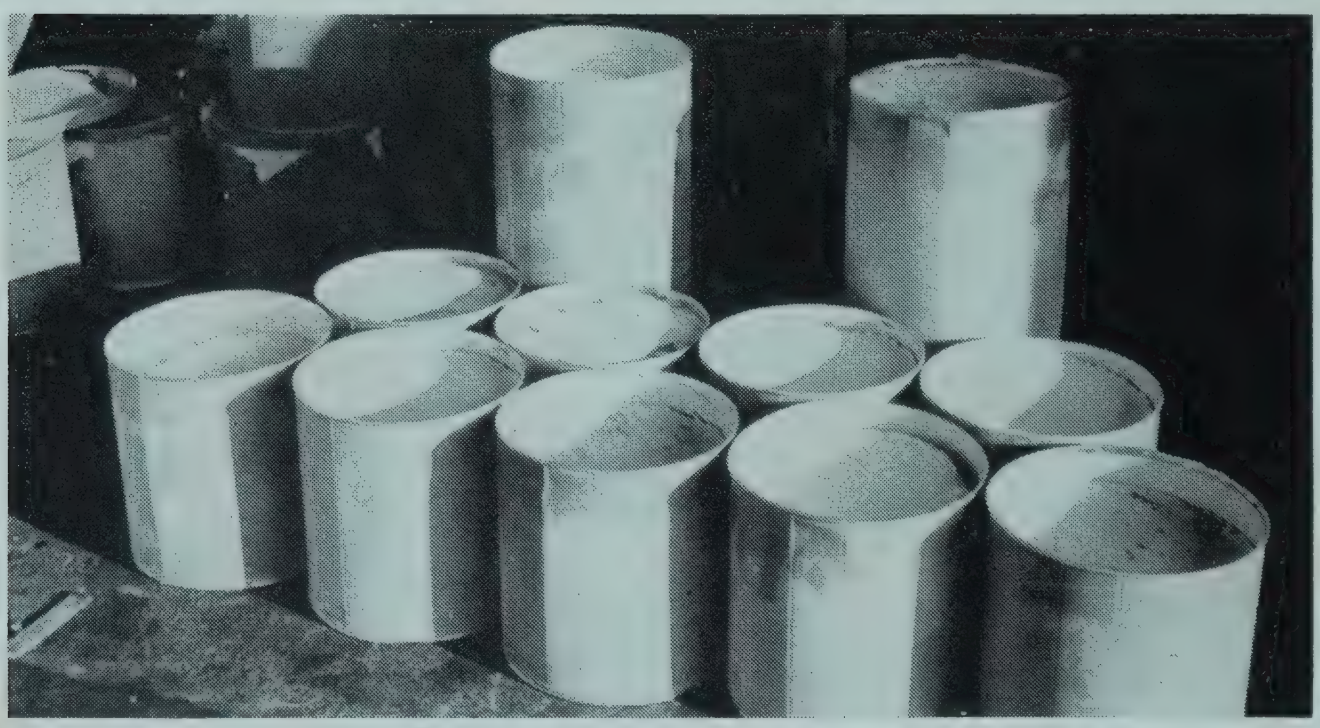
The disadvantages of strainers and filters for removing foreign materials are (1) it is almost impossible to sanitize these utensils after they are assembled for use, (2) they encourage the operator to use contaminated ingredients, erroneously thinking that strainers and filters will remove bacterial contamination, and (3) they tend to encourage carelessness on the part of the operator. However, in commercial practice they have some advantages such as (1) preventing serious damage to expensive equipment by bolts, wrenches, rings, buttons, *etc.,* dropping into vats or ice cream hopper either accidentally or through carelessness of employees, and (2) catching such other foreign substances as should not, but sometimes do, get into the milk, cream, or ice cream mix.

But foreign substances such as buttons, hairpins, jewelry, *etc.,* sometimes gain access to the hardened ice cream after it leaves the factory, when lids are removed while handling cans for storage in retail cabinets or for dispensing

the ice cream over the counter. Hence precautions against these mishaps should be taken at every step from the factory to the consumer.

"Pancakes," a taffylike deposit at the bottom of the package, is similar to the defect "bleeding" in ices and sherbets. When hardened these so-called pancakes are very coarse and unpalatable. Conditions favoring this defect are (1) storage at too high a temperature, near the melting point of the ice cream, (2) draining the freezer too completely, *i.e.,* collecting unfrozen mix, (3) a weak body due to an improper balance of the mix constituents, such as a high sugar content, low concentration of stabilizer, and low total solids content. Although not specifically mentioned on the score card, this defect is serious and greatly reduces the score.

"Shrinkage" adequately describes a particularly vexatious defect. After well-filled packages are hardened, the volume of the ice cream shrinks leaving a space either at the top or side of the package which then appears "not full." It is probably a special type of the "weak" body defect combined with



Courtesy, Dr. D. J. Hankinson, University of Massachusetts.

Fig. 39. Appearance of Ice Cream after Shrinkage defect develops.

a texture defect (therefore closely associated with whipping ability) and becomes apparent with certain temperature changes or types of package. Although it has been widely studied, and many factors have been suggested as causes, it is still difficult to produce at will; in fact, frequently it occurs in only a portion of the packages frozen under similar conditions from the same batch of mix. Conditions accepted as probable causes include: (1) neutralization of the mix or some of the ingredients used; (2) containers that are porous to air, such as paper not properly waxed on the side in con-

tact with the ice cream; (3) abnormally low temperatures either when freezing, drawing from the freezer, hardening in tunnels or hardening by dry ice before storage; (4) conditions favoring bleeding or pancakes; (5) excessive overrun as in fluffy texture (though the product may not appear fluffy the air content may be greater than can be contained at conditions to which the product is exposed); (6) excessive smoothness (the texture is too fine grained) possibly results from an unusual combination of conditions, such as too rapid freezing, which favor the formation of small-sized particles, and conditions arising from a combination of emulsifiers, as yet not too well understood, but which seem to favor very small air cells; (7) texture that favors curdy melt down—*i.e.,* partially destabilized protein. Shrinkage, although not specifically mentioned on the score card, might be expected in ice cream receiving severe criticism for weak body.

THE SCORE CARD

Ice cream as yet is not sold on the basis of score. However, the score card is a convenient tool or guide with which to measure the degree of perfection of any given ice cream. The ideal or standard as indicated by the highest score on the score card serves as the measuring stick by which to compare or judge the ice cream. Some practice in the use of the score card should be valuable in improving the quality of ice cream. The reliability of the score depends partly upon the judge's conception of the ideal standard and partly upon his ability to recognize even very slight defects. The degree of perfection or score may or may not agree with the acceptability of the ice cream in a certain market area, although there is usually a rather close agreement.

The use of the score card. The purpose of scoring ice cream is to emphasize the degree of perfection and the opportunity for improvement. Table 28 is an approximate summary of the relative significance of the defects as described in previous paragraphs of this chapter. For example, a slight feed flavor would score between 36 and 37 points, while a definite feed flavor would score between 34.5 and 35.5 points. Similarly, ice cream criticised for unclean flavor should not be scored above 34.5 points.

A defect is considered (1) "slight" when recognized by the connoisseur but not detectable by most consumers; (2) "definite" when detectable by many consumers; (3) "pronounced" when detectable by most consumers Usually the defects are scored to the nearest half point, and a product with a score below the "normal range" should generally be considered unsalable.

MARKET GRADES

Market grades or classes have not as yet been accepted in the ice cream industry in spite of the fact that many consumers would welcome a system

TABLE 27. THE OFFICIAL ICE CREAM SCORE CARD[a]

Write scores opposite the rating for perfect score. Check criticisms in the space opposite the defects noted and in the proper sample column.

		Sample Number			
Perfect Score	*Criticisms*	1	2	3	4
Flavor 45	No criticism 40-45 Normal range 31-40				
	Cooked				
	Egg				
	Feed				
	High acid				
	Lacks fine flavor				
	Lacks flavoring				
	Lacks freshness				
	Lacks sweetness				
	Metallic				
	Neutralizer				
	Old ingredient				
	Oxidized				
	Rancid				
	Salty				
	Storage				
	Unclean				
	Unnatural flavoring				
Body and texture 30	No criticism 29.5-30 Normal range 25-29.5				
	Buttery				
	Coarse or icy				
	Crumbly				
	Fluffy				
	Sandy				
	Soggy				
	Weak				
Melting quality 5	No criticism 5 Normal range 4-5				
	Curdy				
	Does not melt				
Color and package 5	No criticism 5 Normal range 3-5				
	Color uneven				
	Color unnatural				
	No parchment				
	Rusty can				
	Unclean can				
Bacteria 15					
Total 100	Total score of each sample				

[a] Example of a typical score card. Minor changes are made from time to time, and for specific purposes.

Table 28. Use of the Score Card

	Flavor Scores						
Defect or Criticism	40 - 45	38.5 - 39.5	37.5 - 38.0	36.0 - 37.0	34.5 - 35.5	33.0 - 34.0	31.0 - 32.5
ooked	.....	slight	definite	definite	pronounced	.....	.....
gg	.....	definite	pronounced	.....	.....	.....	.....
ed	.....	.....	.....	slight	definite	pronounced	pronounced
gh Acid	.....	.....	.....	slight	definite	pronounced	pronounced
cks fine flavor	.....	definite	pronounced	.....	.....	.....	.....
cks flavoring	.....	definite	pronounced	.....	.....	.....	.....
cks freshness	.....	definite	pronounced	.....	.....	.....	.....
cks sweetness	.....	definite	pronounced	.....	.....	.....	.....
etallic	.....	.....	.....	slight	definite	.....	.....
eutralizer	.....	.....	.....	.....	.....	slight	definite
d ingredient	.....	.....	.....	slight	definite	pronounced	pronounced
xidized	.....	.....	.....	slight	definite	definite	pronounced
ncid	.....	.....	.....	.....	.....	slight	definite
lty	.....	.....	.....	slight	definite	pronounced	pronounced
orage	.....	.....	.....	slight	definite	pronounced	pronounced
o high flavor	.....	definite	pronounced	.....	.....	.....	.....
o sweet	.....	definite	pronounced	.....	.....	.....	.....
nclean	.....	.....	.....	.....	.....	slight	definite
nnatural	.....	.....	.....	slight	definite	pronounced	.....

TABLE 28. THE USE OF THE SCORE CARD—*Continued*

Defect or Criticism	*Body and Texture Scores*				
	29.5 - 30	29.0 - 27.5	27.0 - 26.5	26.0 - 25.5	25.0
Buttery	.....	.....	slight	definite	pronounced
Coarse or icy	.....	slight	definite	pronounced	pronounced
Fluffy	.....	slight	definite	pronounced	pronounced
Sandy	.....	.....	slight	definite	pronounced
Soggy	.....	slight	definite	.....	.....
Weak	.....	slight	definite	pronounced	pronounced
	Melting Quality Scores				
	5	4.5	4.0		
Curdy	.....	slight	definite		
Does not melt	.....	slight	definite		
	Color and Package Scores				
	5	4.5	4.0 - 3.5	3.0	
Color uneven	.....	slight	definite	pronounced	
Color unnatural	.....	slight	definite	pronounced	
No parchment	.....	.....	definite	.....	
Rusty can	.....	.....	slight	definite	
Unclean can	.....	slight	definite	pronounced	

of market grades. The fluid milk or market milk industry has a widely accepted system of market grades in which the methods of producing and handling the milk receive more emphasis than does the score, *i.e.*, its degree of perfection. These market grades of milk are closely associated with the relative value of the milk not only to the consumer but also as determined by the cost of production and distribution. Similarly the market grades of butter are closely associated with the score, even though the distinction between the grades is based primarily upon the relative value of the butter to the consumer. A similar system of market grades based primarily upon the relative value to the consumer might be beneficial to the ice cream industry.

Suggested market grades for ice cream. Table 29 suggests a possible system of market grades together with the approximate correlation to the ice cream score. It should be recognized that the score primarily measures differences in degree of perfection which may not represent significant differences in value to the consumer—the latter differences being the primary distinction in market grades. Therefore, a market grade will include a range of scores all of which will represent the same market value to the consumer.

TABLE 29. A SUGGESTED CLASSIFICATION OF MARKET GRADES FOR ICE CREAM, SHERBETS AND ICES

	Market Grades[1]					
Factors	1st Quality	2nd Quality	3rd Quality	4th Quality	5th Quality	No Grade[2]
Fat Content[3]	Not less than 14.0%	Not less than 11.0%	Not less than 10.0%	Not less than 10.0%	Not less than 8.0%	
Flavor Score	Not less than 40.0	Not less than 37.5	Not less than 36.0	Not less than 33.0	Not less than 30.0	
Sum of scores on body and texture, melting quality, color and package	Not less than 39.5	Not less than 37.0	Not less than 34.5	Not less than 33.0	Not less than 30.0	
Plate Count Ratio[4]	Not less than 4.0	Not less than 2.0	Not less than 1.5	Not less than 1.0	Not less than 0.9	
Coli Test	Negative	Negative	Negative	Negative	Positive	

[1] To be admitted to a certain grade the requirements for each factor must be met.
[2] Any ice cream that does not conform to the requirements of higher grades.
[3] Values are for plain ice cream. Fruit and nut ice creams might be 2 per cent lower—i.e., 12 per cent for first quality.
[4] This ratio is determined by dividing the legal standard by the actual plate count of the ice cream.

CHAPTER XIX

SANITIZATION

Wholesome quality is the first and most important requisite for all frozen desserts. However, almost as important are healthy employees, sanitary minded, in sanitary attire, with laboratory facilities, and the necessary laboratory equipment to make sanitary tests and checks on the effectiveness of cleaning solutions which are the essentials in cleaning operations. All these sanitary procedures are included in the term **sanitization** which, briefly, is the use of methods and materials to preserve or restore hygienic (healthful) quality. In other words, to assure a sanitary product, sanitization must be maintained with hygienic equipment by hygienic employees in hygienic surroundings.

The usual methods of measuring sanitary quality include the sediment test, the standard plate count for bacteria, the coliform test, and the usual tests for proper pasteurization. These combined tests will help indicate whether there has been contamination with pathogenic (disease producing) bacteria and careless methods of handling. However, they do not measure toxic (poisonous) materials resulting from certain types of spoilage or from the use of ingredients containing them. There are also some unsanitary practices, such as straining out flies and other foreign materials, or contamination with undesirable soluble materials which are not easily detected. The hygienic quality of poor ingredients cannot be corrected even though pasteurization does destroy whatever pathogenic bacteria are present. Therefore, the need for conscientious, constant detailed attention is apparent.

SANITARY EQUIPMENT

Washing and rinsing. The importance of thorough washing and rinsing cannot be over-estimated in making equipment hygienic. Either sterilizing or sanitizing is very difficult, if not impossible, when the equipment is not thoroughly cleaned. Thorough washing also offers an excellent opportunity to inspect the equipment for wear, loss of tinned surface, rust, pitting, *etc.* The first step in washing any piece of equipment is **rinsing with lukewarm** (80° — 110° F.) **water** to remove milk remnants. **Soaking** may be necessary when the milk film has been allowed to dry. Rinsing should be followed by **vigorous scrubbing** with a stiff-bristled brush and hot (115° — 120° F.) water containing a washing powder (cleaning agent). Extra effort should be applied to corners and any other places that are difficult to reach. This scrubbing is essential for removing the film that remains after the visible milk, fat, or foreign material has been removed. A stream of washing solution under pressure can be as effective as a brush. The outside of the equipment also should receive the same careful washing treatment. When the

surface has been scrubbed to a high polish with washing solution, it should be **rinsed** again with clean, warm water (100° — 110° F.), sufficiently rinsed to remove the thin film of washing solution. When this process is carefully done, the equipment will have a bacteria count not exceeding that of the final rinse water.

Washing powders (cleaning agents) should contain no soap because this ingredient leaves a surface film which is difficult to rinse away. Free alkalis, as sodium hydroxide and caustic, should not be used on metallic surfaces if corrosion is to be prevented. Sodium metasilicate, sodium carbonate (washing soda), and tri-sodium phosphate are satisfactory types of cleaning agents. The effectiveness of these materials is improved by a small amount of so-called "wetting agents" (*i.e.*, materials like sulfonated alcohols sold under various trade names like "dreft," "syntex beads" *etc.*). Water containing appreciable amounts of calcium or magnesium is described as "hard" water. The use of such water is a contributing cause of a deposit known as "milkstone" on the surface of the equipment. This can be avoided by adding a "water-softening" agent (such as pyrophosphate or metasilicate) to the washing compound, but these are not necessary when "soft" water is used. A very satisfactory cleaning agent for use in hard water may be prepared by thoroughly mixing 100 lb. trisodium phosphate with 20 lb. tetrasodium pyrophosphate and 2 lb. syntex beads. Where soft water is available, excellent results are obtained from a mixture of 40 lb. trisodium phosphate, with 60 lb. sodium carbonate and 2 lb. syntex beads. Preparing these mixtures is somewhat troublesome even though it frequently is more economical. There are many similar mixtures available under trade names, and these give equally good results.

Sterilizing of the equipment should follow the washing and rinsing processes. Ideally, sterilizing will kill all organisms on the equipment — a goal that is desirable and not impractical. However, most commercial workers and many milk sanitarians are satisfied with merely preventing "public health hazards" and therefore substitute sanitizing for sterilizing.

Sanitizing kills all pathogenic organisms but may leave a few bacteria (so-called "reasonably small number" or "insignificant number"). It is a less expensive, less exacting, and less time-consuming process than sterilizing, although the same two groups of agents are used. For example: Heat (as hot water) of 170° F. for ten minutes will sanitize, while heat (as steam under 15 lb. pressure) of 240° F. for 15 minutes will sterilize.

Sanitizing Agents.—The recommended sanitizing agents together with their advantages and the precautions to be observed in using them may be outlined as follows:

1. **Heat** is the most reliable agent, especially when both temperature and

time are carefully controlled. Its main advantages are its penetrating ability and the fact that it facilitates drying of the equipment.

a. Dry heat at 240° F. for 5 minutes sanitizes.
b. Steam under pressure (15 lb. or 240° F.) for 5 minutes sanitizes.
c. Steam at zero pressure (212° F.) for 10 minutes sanitizes.
d. Hot (so-called "boiling") water (180° — 212° F.) for 10 minutes sanitizes.

Lower temperatures or shorter time at the temperature will not properly sanitize or leave the equipment dry.

2. **Chemical agents** are effective only under four conditions: (1) When the surface is entirely cleaned, (2) when the surface is in intimate contact with the chemical, (3) when there is sufficient concentration of the active constituent of the chemical, and (4) when there is sufficient time of contact with the surface. The first three requirements are difficult to satisfy. Many mechanical washers do not clean the surface sufficiently for chemical sanitizing agents. Furthermore, pipe lines may appear to be completely filled with sanitizing solution and yet contain air pockets which will prevent complete sanitization. This is especially true of fittings, joints, and pumps. Also, vat covers may not come in contact with the chemical agent. The concentration of the solution will change if the chemical agent is not properly stored, or if it is used repeatedly, or if it is used for too many pieces of equipment.

Temperatures of 110° F. or more usually cause rapid loss of concentration, and therefore chemical sanitizing agents should be used and stored at lower temperatures. Since low temperatures are used, the equipment is seldom left dry. This is a serious objection, for moisture even without the chemical will favor corrosion of the equipment. However, this low-temperature sanitizing has three advantages: (1) It permits sanitizing immediately before the equipment is to be used, when hot equipment would be injurious to the quality of the milk. (2) It avoids excessive strain on equipment which occurs by expansion and contraction when high temperatures are used. This is particularly important in freezers and equipment having stuffing boxes, as in pumps. (3) It encourages the flushing out of equipment immediately before use, thereby removing any possible dust that may have entered the cans or equipment.

Types of Chemical Sanitizing Agents.—Only three types of chemical sanitizing agents have sufficiently pleasing odors to permit their use; all others have odors which are objectionable in dairy products. There are many trade-named products containing one of these three types as the active ingredient.

a. **Hypochlorites,** usually sodium hypochlorite, are rapid in action, lose strength easily, and are rather corrosive on equipment. Sanitizing solution

should contain not less than 50 parts (many recommend as much as 200) of available chlorine per million parts of solution. The solution should be in contact with the surface for at least 15 seconds.

Sodium hypochlorite is prepared by the electrical decomposition of salt in a slightly alkaline solution and many preparations are available under trade names.

It may also be prepared in a stone crock as follows: To 4 lb. of "chloride of lime" add 5 gallons of water, and to this add 1½ lb. of washing soda. Thoroughly mix with a wooden paddle and allow to stand until the lime settles to the bottom. Then drain off the clear solution into a bottle. Use one-half pint of this solution to 2 gallons of water for a sanitizing solution.

b. **Chloramines** are available under many trade names. Chlorine is the active ingredient as in the hypochlorites. These are less rapid in action, lose strength less rapidly and are less corrosive than the hypochlorites. Sanitizing solutions should contain not less than 50 parts of chlorine (many recommend as much as 200) per million parts of solution. The solution should be in contact with the surface for at least one minute.

c. **Quaternary ammonium compounds.** Several compounds of this type are available on the market, but their advantages and limitations are not yet well established. However, at the present time investigational work indicates some probable special advantages, such as: (1) a less objectionable odor, (2) less severe corrosive action, (3) less loss of efficiency in the presence of small quantities of organic matter, (4) greater stability when used at temperatures of 120° — 150° F., and (5) greater efficiency in the presence of alkali cleaning agents. The addition of a chemical sanitizing agent to the wash water containing a cleaning agent appeals to the uninformed person who would like to wash and sanitize in one operation. However this would seem to be an absurd practice since the purpose of using a sanitizing agent demands that it be used after (instead of while) the equipment is cleaned and rinsed. Therefore an attempt to combine the two operations is as erroneous as an attempt to dry the equipment while spraying it with rinse water. Among the probable limitations are (1) a recommended concentration of not less than 200 parts per million, and (2) less efficiency for certain individual organisms (whether these are commonly found in dairy plants is not yet known).

Drying is the last process in sanitization. It should be accomplished by heat and ventilation; never by the use of a cloth or towel of any kind. While sanitization is not complete without drying, the drying process may be omitted when the equipment is to be immediately refilled with a dairy product. Drying is essential to reduce deterioration and corrosion. It also inhibits the growth of organisms that may find access to the properly cleaned, rinsed, and sterilized surface. Drying should also be accompanied

by ventilation insofar as this is possible without recontamination. Re-sanitizing with a chemical agent immediately before the dried equipment is put into use again is advisable.

SANITARY SURROUNDINGS

Equipment can be kept more uniformly hygienic in sanitary surroundings *i.e.*, in rooms having hygienic construction and kept sanitary by hygienic personnel. All rooms, even toilets and locker rooms, of the factory should be kept sanitary by the same method described for producing hygienic equipment.

Hygienic construction is probably more important than hygienic methods, since it encourages hygienic practices, especially at an economical cost. The essential factors in hygienic construction are very similar for utensils, equipment, work rooms, buildings, and surroundings. They may be listed as:

1. Surfaces should be smooth and free from scratches and grooves. This is particularly essential for surfaces coming in contact with the product, such as the inside of utensils and equipment. Floors of work rooms are the only exception, and these should be slightly rough (like the commonly known "wood finish" on concrete) to prevent accidents by slipping on the wet floor.

2. Surfaces should be sloping and free from depressions that do not drain quickly and completely. This is desirable not only in equipment but also for all floors, window sills, ledges, shelves, *etc.*

3. Corners should be rounded and large enough to permit scrubbing with a brush. Sharp corners and crevices must be avoided in surfaces which come in contact with dairy products. In walls, floors, the outer surface of equipment, *etc.*, sharp corners and crevices are objectionable because they are difficult to get completely clean.

4. All surfaces should be easily accessible for scrubbing. Pipe fittings should be tees, never elbows, and easily dismantled to permit visual inspection for cleanliness. Coils in vats should not interfere with scrubbing the entire surface of the coil and the vat. Equipment should be mounted on the floor so as to permit scrubbing the floor instead of leaving corners and floor space under the equipment that cannot be scrubbed daily.

5. Materials used in construction should be impervious to moisture and free from objectionable odors. Certain woods and paints have odors that are easily absorbed by dairy products. Some metals tend to dissolve in the product and to cause undesirable flavors which are frequently described as "cardboard," "tallowy," or "metallic." This injurious effect can be avoided by covering the metal with a film or coating of tin. When such tinned equipment is used it should be frequently inspected for small spots where the tin coating has been removed by scratching or wear. Most modern

equipment is made from stainless steel which has no injurious effect on the flavor of dairy products.

6. Light is essential for proper cleaning. It should be available especially during cleaning operations without interfering with the operation (*i.e.*, the operator should not have to stand in the light and cast a shadow on the surface being scrubbed).

7. Ventilation with fresh, clean air is essential. All equipment, utensils, and all rooms, cupboards, *etc.*, should be constructed to permit thorough ventilation without contamination. This not only avoids undesirable odors but reduces the objectionable moisture in the atmosphere.

8. Rodents and insects should have no place to collect or hide. Dark places, moist places, and unclean places, attract rodents, ants, roaches, flies, *etc.* Removal of all such places eliminates the pests. Sprays, poisons, screens, and traps should be used only as a temporary measure, preferably not at all. Neither the pest nor the usual "control measures" belong in a respectable dairy, and either one is evidence of careless methods.

9. Segregation of operations is necessary in the construction of buildings. There should be separate rooms for unpasteurized or raw products to avoid contamination of equipment and possible mixing of unpasteurized with pasteurized products; for products with pronounced odors that may be easily absorbed by other products; for wash rooms, for cans, bottles, *etc.;* for boilers, engines, refrigeration compressors, *etc.*; for all storage rooms whether refrigerated or not; and for rest rooms (toilets) and locker rooms.

10. Special facilities are necessary in the construction of buildings and work rooms. Conveniently located facilities for obtaining an ample supply of both hot and cold water are most essential. The supply of both hot and cold water should be unrestricted if cleanliness is expected. Mixing outlets, permitting adjustment of temperature, should be located for convenience in applying an ample supply of water to all parts of every room. Floor drains in each room are equally essential. They should be located so as to drain the floor completely and not leave even shallow puddles. When possible it is desirable to locate them at the sides or at least out of the traffic lanes, but they must be easily accessible for cleaning when they become clogged; for this reason they are often located in the center of the room. A most important special feature of each room is a lavatory, *i.e.*, a small basin for washing hands. This lavatory should be equipped with a mixing faucet for hot and cold water, soap or cleaning agents, a cold water drinking fountain, and single service (paper) towels. Thus personal cleanliness is encouraged, and the improper use of equipment (such as sinks for washing utensils, drinking from a hose, contamination by handling equipment with dirty hands) is avoided.

Hygienic personnel is probably the most important factor not only in ob-

taining but also in maintaining healthful quality in the product. Every person associated with dairy products should be hygienic-minded and constantly observant of sanitary details. This applies to such persons as mechanics, electricians, janitors, stenographers, truck drivers, *etc.,* as well as to persons actually operating equipment for processing the dairy product. The three characteristics of hygienic personnel may be listed as follows:

1. Hygienic conscience, or a subconscious desire to employ only healthful practices and habits as well as a determined conscious effort to correct errors in hygienic behavior.

2. Physical health, especially freedom from contagious diseases. Medical examination for contagious diseases (particularly typhoid which supports "carriers") should be required once a year. Rigid isolation should be practiced even in the event of less fatal contagious diseases such as common colds.

3. Hygienic habits including innumerable personal details such as the following:

a. Hands and nails should be clean. The hands should be washed before touching dairy products or clean utensils; especially after touching unsterile cans, shaking hands with anyone, coughing against the hand, wiping the nose, scratching, visits to the toilet, *etc.*

b. Insanitary practices such as coughing in or near the equipment, spitting on the floor, *etc.,* should be avoided.

c. A net or cap should be worn to prevent loose hair from contaminating the product or equipment.

d. Clothes should not be worn longer than one full day between launderings, and should be changed oftener when they become untidy. Clothes worn on the street or outside of the work-room should not be worn while handling the product. Footwear used while cleaning larger vats that must be entered should not be worn elsewhere, even on the floor of that room.

e. Wounds or sores should be bandaged to prevent any possible contact with the equipment or product. Wet equipment may make contact by soaking through the bandage. When this cannot be avoided the person should not touch the equipment or product.

The recontamination problem is very complex because (1) the product is exposed to so much equipment, some of which is difficult to sanitize, and (2) the product is exposed to human contact. Hygienic ingredients can be reasonably assured by obtaining bacterial counts on all products used in the ice cream. Bacterial counts and coliform tests on samples of ice cream taken at various places between the pasteurizer and the retailer aid in discovering recontamination. Wherever possible human contact should be eliminated, and where it cannot be avoided the health of the worker should

be supervised and he should be compelled to practice hygienic habits. Some sanitarians believe that:

1. Every employee should be required to have a complete medical examination by a competent physician and submit the necessary samples of blood, feces, and urine for laboratory examination, together with any other test necessary, at the time he is employed and semi-annually thereafter. If the Board of Health does not require such an examination, the employer should require it for his own protection.

2. Supplementing the above examination and as an added protection all employees coming in direct contact with food, milk, or other dairy products should be examined regularly by a nurse, foreman, or some other competent person for evidence of contagious diseases. By means of education and intelligent application, many causes of potential or actual disease may be found in this way.

3. Whether this system or any other is used in trying to find persons suffering from contagious disease, employees must not be penalized by being discharged or temporarily laid off without due compensation.

4. Only persons who are inherently clean should be employed in the food or dairy industry. All new employees should be watched carefully until they have been so classified.

CHAPTER XX

REFRIGERATION

Refrigeration is the removal of heat from a substance and therefore is concerned with heat exchange (*i.e.,* heat transfer). The excess heat in the substance being cooled (refrigerated) is transferred to a cooler substance which becomes heated. Therefore "refrigeration" is the reverse of "heating," both occurring simultaneously and being dependent upon the same principles and factors of heat exchange. However, the ice cream industry uses the term "refrigeration" to mean the production of temperatures below 40° F., mainly between 40° and –30° F.

METHODS OF REFRIGERATION

The Ice and Salt Method. Natural ice, in very early times, was harvested from ponds and stored to be used for refrigeration. Since ice melts at 32° F., lower temperatures could be obtained only by mixing ice and salt. This method, now called "the ice and salt" method, is being used when only a small amount of refrigeration is required. Under usual conditions it is not practical to obtain temperatures below 0° F. by this method, although theoretically –6° F. is possible when using 1 lb. of salt to 3 lb. of ice. The lowest temperature obtained by this method depends upon the proportion of ice and salt, the rate at which heat is supplied, the density of the brine, the original temperature of ice and salt before mixing, and the size of both the ice and salt particles. Smaller lumps of ice and more concentrated brine favor rapid cooling and are used when the rate of heat transfer is high.

Mechanical refrigeration is now very widely used and has the advantages of: less labor, less cumbersome, lower temperatures available, more uniform temperature control, more rapid, cleaner, and drier. It is based on the principle that a liquid absorbs heat when it vaporizes, as in the case of water changing into steam, and the vapor can be collected, cooled to a liquid, and used again. The particular liquid, called "refrigerant," used in a mechanical refrigeration system depends upon many factors. Some of the more important of these factors are: (1) the boiling point of the liquid, (2) pressure characteristics (the pressures under which it can be used), (3) the latent heat of vaporization (amount of heat absorbed when the refrigerant vaporizes), (4) the ease with which a leak is detected, (5) its corrosive action on metals used in the system, and (6) its toxicity.

TYPES OF REFRIGERANTS COMMONLY USED

Of the many and various refrigerants, only two have been found sufficiently satisfactory to be widely used in the ice cream industry: **ammonia,**

which has been used a long time, and **"Freon-12,"** a representative of the non-toxic refrigerants used in ice cream cabinets, in small installations (home refrigerators, counter freezers, *etc.*), and where very low temperatures are not required.

The most important advantages of ammonia are: (1) it absorbs a large amount of heat when vaporizing, (2) operating pressures are reasonably convenient, (3) leaks are easily detected, (4) its toxicity is not great though its odor is very pungent, and it has a very pronounced irritating effect on mucous membranes and wet skin, and (5) it usually operates at pressures above atmospheric, thereby keeping foreign gases and liquids out of the system.

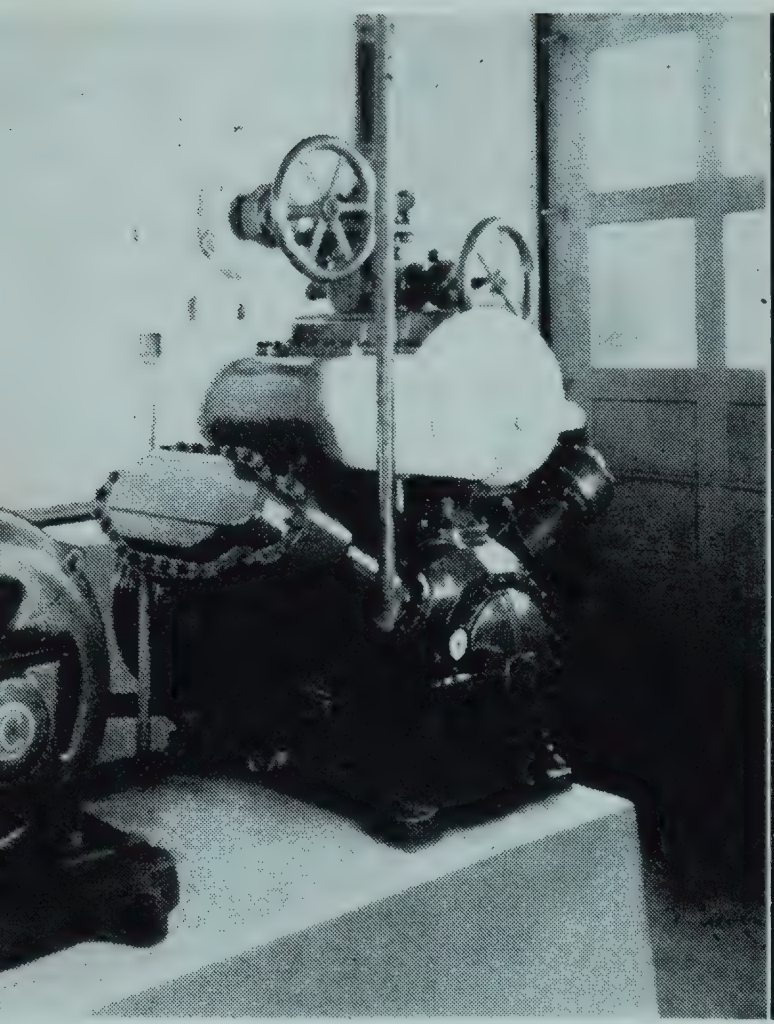
Its main disadvantages are: (1) it is very corrosive to brass and other copper alloys (since only iron and steel can be used in the system, the equipment is rather bulky), (2) the relatively large volume of gas requires large compressors, (3) mechanical automatic operation is difficult to obtain, (4) maintenance of temperature within a narrow range is difficult, (the last two of these disadvantages are due to the large amount of heat absorbed during vaporization but are not significant in many installations), and (5) for some installations the objectionable odor from even minor leaks becomes very important.

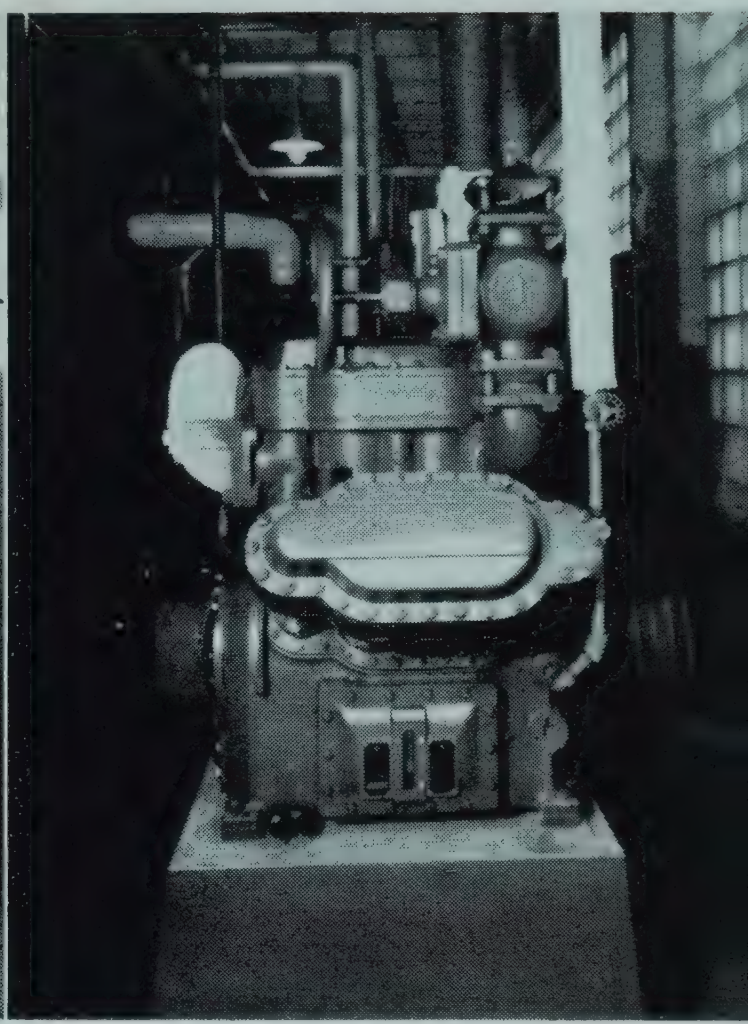
Freon-12 is one of the many Freon refrigerants. The advantages of these refrigerants are: (1) they require lower operating pressures, (2) their odor is neither objectionable nor toxic, (3) they are not injurious to food materials, (4) they are not corrosive to usual metals, although alloys containing magnesium must be avoided, (5) smaller and more compact refrigeration systems can be used because of the lower pressures and the use of copper alloys (hermetically sealed units are becoming popular), (6) they are carriers for oil thus facilitating the lubrication of compressors, (7) mechanical automatic operation is fairly simple, and (8) more uniform temperatures can be maintained.

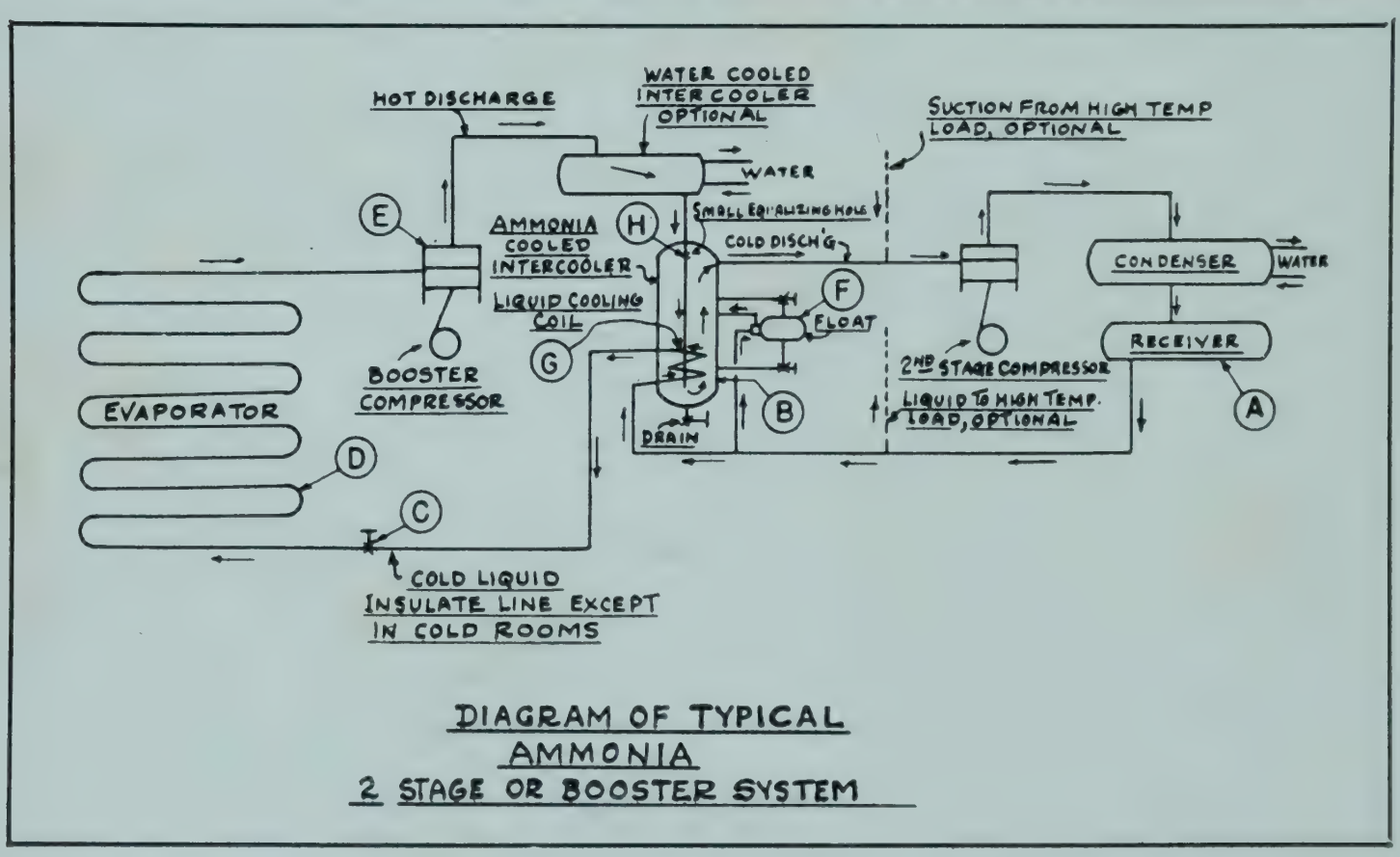
The main disadvantages of Freon refrigerants are: (1) they must be free of moisture, (2) leaks are not easily detected (a special Halide torch which gives a pink flame in the presence of Freon can be used to detect leaks), (3) the system must be tighter than for ammonia to avoid leaks (small leaks are not noticeable and the refrigerant may be lost just when it is most needed), and (4) they are less satisfactory than ammonia for very low temperatures.

PRINCIPLES OF MECHANICAL REFRIGERATION

The mechanical refrigeration system consists of only three essential parts: (1) the compressor, (2) the "high pressure side," and (3) the "low pressure







Courtesy, Creamery Package Mfg.

Fig. 40. Typical Ammonia 2-Stage or Booster system.

side." **The compressor** consists of one or two cylinders, usually surrounded by a water-jacket for cooling, and containing pistons, similar to those of a gasoline engine, operated by a crank shaft that runs in oil in the crank case. The compressor is usually belt-driven from a motor, engine, or other source of power. The purpose of the compressor is to concentrate the vapor. It takes the vapor from the "low pressure side," of large volume at low pressure and low temperature, and discharges it into the "high pressure side." Thus the compressor occupies one of the two positions dividing the high and low sides. The "high pressure side" extends from the compressor to the so-called "expansion valve" and includes the "condenser" and "receiver." The hot vapor leaving the compressor passes through the condenser, *i.e.,* coils of pipe which are cooled by water or air. This cooling in the condenser changes the vapor into a liquid at about room temperature and still under a high pressure, the liquid being collected in a tank (the "receiver"). This liquid refrigerant passes on to the "expansion valve" which is the other position dividing the high and low sides. The "low pressure side" extends from the expansion valve to the compressor. The expansion valve is usually an ordinary needle valve permitting fine adjustment and may be operated manually. It derives its name from the fact that the liquid refrigerant passes through the valve and then expands into a vapor. The liquid refrigerant is under high pressure at room temperature before passing through the valve, and under low pressure at low temperature as it leaves the expansion valve to go through the "expansion coils," *i.e.,* coils of pipes located where refrigeration is to be produced, and leading back to the compresssor. In this way the refrigerant is used repeatedly, being compressed, condensed, and expanded. The refrigerant never wears out, but slight leaks invariably occur making it necessary to replenish the supply. The refrigeration or cooling is obtained by means of the expansion coils since in these coils the liquid refrigerant absorbs heat while vaporizing. The pressure in these expansion coils determines the lowest temperature obtainable, and this pressure is often called the "suction pressure" or "back pressure" of the system. The expansion coils may be located in the hardening room, in a tank of water or brine, in the ice cream freezer, *etc.,* to give refrigeration in that particular place.

A large amount of heat is absorbed as the liquid changes to a vapor, and a smaller amount of heat is absorbed by the vapor when it expands further. This heat which is absorbed in the expansion coils is carried in the vapor to the compressor and on to the condenser where the heat is transferred from

the hot refrigerant vapor to the cooling water or air around the condenser coils. Sometimes this cooling water is used only once and wasted, in other places it is more economical to re-use this water. In these cases the water is pumped to the top of a "cooling tower" (usually on the roof) and allowed to trickle down over the tower, being cooled by partial evaporation in the process. This proves very economical where the cost of water is high. In some Freon systems the condenser is air cooled, usually by a fan blowing air around the condenser coils that have fins to facilitate radiation of the heat.

Although the principle involved in the mechanical refrigeration system is rather simple, the construction and installation is too complicated for a brief discussion. Usually it is more economical to obtain the services of a refrigeration engineer to supervise the planning and installation of the system.

OPERATING PRECAUTIONS

Precautions to observe in operating refrigeration systems are:

1. When opening valves on refrigerant lines, open them slowly.

2. Keep the suction pressure as high as possible. It must be sufficiently low to give the desired temperature. The pressure on the low side should correspond to an ammonia boiling point 10° F. lower than the temperature of the brine (or other medium surrounding the expansion coils) for maximum efficiency. A lower back pressure than this reduces the refrigeration capacity. There is a temperature drop of about 10° F. between the brine and the ammonia due to the wall of the expansion coil. This is the same principle as in a milk cooler. The cooling medium must always be cooler than the temperature to which it is desired to cool the milk. Table 30 shows the boiling point of ammonia at different gauge pressures.

TABLE 30. THE RELATION OF GAUGE PRESSURE TO BOILING POINT OF AMMONIA

Gauge Pressures lb. Per Sq. In.	*Boiling Point of Ammonia Degrees F.*	*Minimum Brine Temperature Degrees F.*
+ 1.17	—25	—15
+ 3.45	—20	—10
+ 5.99	—15	— 5
+ 8.77	—10	— 0
+10.93	— 5	+ 5
+15.37	— 0	+10
+19.17	+ 5	+15
+23.55	+10	+20
+27.93	+15	+25
+32.95	+20	+30
+38.43	+25	+35
+44.41	+30	+40

To illustrate: If a minimum brine temperature of ten below zero is wanted, the pressure on the low pressure gauge should be that at which ammonia will boil at —20° F. or 3.45 lb. per sq. in. Table 30 shows that it is not necessary to carry a vacuum on the low side unless extremely low temperatures are desired. Head pressures are determined by the temperature of the refrigerant in the condenser.

3. Keep the "head pressure" or pressure on the high side as low as possible. This saves power. The head pressure depends on (a) size of the condenser, (b) temperature of water used for cooling the condenser, (c) amount or volume of water flowing through the condenser, (d) impurities in the refrigerant (mainly oil and air), (e) cleanliness of the condenser outside as well as inside.

4. Avoid operating the compressor at zero suction pressure or under vacuum, since this favors oil passing out of the compressor into the condenser.

5. Avoid having frost on the compressor. The suction pipe at the compressor should carry frost up to the compressor when operating most efficiently.

6. Inspect and drain all oil traps regularly. Some oil always passes along with the refrigerant and collects at low spots in the system. Valves at these points permit the oil to be drained out, thereby improving the efficiency of the heat transfer. Worn piston rings favor oil passing into the refrigerant.

7. Keep air out of the system. Air and some other gases do not condense into a liquid, but collect at high spots in the system. Valves at these points permit the removal of the air. Air decreases the efficiency of the condenser, causing excessive head pressures. Usually the air is removed at the high point of the condenser; this operation is called "purging."

8. Keep the expansion coils as free from frost as possible. This is especially important in hardening rooms, since frost and ice beyond a certain thickness reduce the rate of heat transfer.

DEFROSTING METHODS

Common methods of defrosting are:

1. Brushing the coils with a stiff or wire bristled brush. This is not very effective as it may leave a thin layer of ice which gradually increases in thickness.

2. Scrubbing with hot water. A wet, messy, disagreeable operation leaving much moisture in the room and warming up the entire hardening room. However, it is nearly always used when the expansion coils are in a separate cabinet through which the hardening room air is circulated.

3. Passing hot liquid refrigerant through the coils. This requires extra valves and pipes in the installation, but does not raise the temperature of the

room much. The frost and ice are easily removed from the quickly heated coils before the ice melts.

4. Passing hot refrigerant vapor or gas through the coils. This is similar to the use of hot liquid refrigerant.

5. Using a brine drip or spray over the coils. A trough containing calcium chloride crystals is placed above the coil so that as the crystals absorb moisture the brine drips down over the coil to collect in a pail at the bottom.

METHODS OF COOLING

The brine method of cooling, sometimes called the "brine system", represents the first application of mechanical refrigeration. The expansion coils of the mechanical refrigeration system are immersed in a large tank of brine (a calcium chloride solution) to cool the brine. Then the brine is pumped through pipes to the freezer (or other place where refrigeration is desired) and back to the brine tank to be cooled again. This method involves additional investment in brine tank, brine solution, pumps, pipes, *etc.* It is less efficient since the heat removed for refrigeration must be transferred to the brine and then to the mechanical refrigeration system. Other disadvantages are the corrosiveness of the brine, the difficulty in obtaining very low temperatures, and the more bulky installation. The most important advantages are that it permits storing up of refrigeration and can be used where ammonia leaks would be dangerous. Although it has been largely replaced in modern factories, it continues to find application in certain operations such as making ice cream novelties and in making artificial ice.

The care of brine systems is important and may be summarized as follows:

1. Test the brine every month for concentration, alkalinity and ammonia.

2. Keep the concentration of the brine high enough to give a freezing point at least 10 degrees lower than the lowest temperature to which it will be cooled. See Table 39. Otherwise, the brine will freeze onto the expansion coil and this ice will act as insulation preventing the heat in the brine from penetrating the expansion coil.

3. Adjust the alkalinity by adding a solution of sodium hydroxide (caustic soda) or of lime until the brine is neutral to litmus or phenolphthalein. If the brine is acid to litmus it is too corrosive.

4. Use only one metal, preferably a pure grade of cast iron, in contact with the brine. Two different metals favor corrosive action.

5. Immerse a bar or strip of zinc in the brine to decrease the corrosion when two different metals are used in the system.

6. Add a solution of sodium dichromate and caustic soda to reduce corrosion; however, this will cause irritation of the skin. Care must there-

fore be used in handling the dichromate, as well as the brine containing it. To make the solution, thoroughly dissolve, by stirring, a mixture of 5 lb. commercial dichromate, 1.4 lb. caustic soda, in one gallon of water. This amount will be sufficient to treat 375 gallons of brine the first time. Once a year it will be necessary to add from one fourth to one half of the original amount.

7. Avoid air coming in contact with the brine since air makes the brine acid and more corrosive. Keep the brine tank covered, and avoid bubbling air through the brine or spraying the brine.

8. Avoid ammonia leaks from the expansion coils which cause the brine to become more alkaline. They can be detected by boiling a sample of brine in a narrow-necked flask and testing the vapors with red litmus paper. If the red litmus paper turns blue the steam from the boiling brine contains ammonia.

The "direct expansion" method of cooling has replaced the brine method in many installations, since it represents increased efficiency and a saving in investment. In this method the brine pipes in the freezer (or other place where refrigeration is desired) are replaced by the expansion coils of the mechanical refrigeration system. These expansion coils may or may not contain much liquid refrigerant in addition to the refrigerant vapor.

The "flooded system" or method of cooling is a special case of the direct expansion method in which the liquid refrigerant collects in the expansion coils nearly filling the coils. The compressor draws off the vapor as the absorbed heat vaporizes the liquid. Thus in the operation of this flooded system the liquid refrigerant under high pressure and room temperature passes through a valve (usually controlled by a float) to the expansion coils where it is a liquid under a lower pressure and lower temperature. As heat is transferred to the liquid refrigerant evaporation takes place; the vapor from this evaporation is constantly removed by the compressor and the liquid level maintaned by the float.

The important advantages of the flooded system are: (1) it is more efficient, since heat is more readily transferred between liquids than between vapors, gas or liquid to gas, (2) less cooling surface or coil surface is needed, (3) there is less fluctuation in temperature. The fact that float valves occasionally stick causing liquid refrigerant to enter and damage the compressor is the main disadvantage.

DEFINITIONS OF TERMS USED IN REFRIGERATION

1. "B.T.U.": British Thermal Unit or the amount of heat required to raise the temperature of one pound of water through one degree Fahrenheit when water has its greatest density (at about 39° F.). Roughly

the amount of heat required to raise the temperature of one pound of water from 39° to 40°F.

2. "Latent Heat of Vaporization": The amount of heat (in B.T.U.) required to change one pound of liquid into one pound of vapor without changing the temperature or pressure.
3. "Latent Heat of Fusion": The amount of heat (in B.T.U.) removed to change one pound of liquid into a solid without changing the temperature or pressure.
4. "Ton Refrigeration": 288,000 B.T.U. per 24 hours or the amount of heat required to melt one ton of ice per day at 32°F. without changing the temperature or pressure. Other convenient "Ton of refrigeration" equivalents are: 12,000 B.T.U. per hour=1 Ton; 200 B.T.U. per minute=1 Ton.
5. "Ton Refrigeration Machine": A compressor or machine that will produce a "ton refrigeration" during 24 hours of continuous operation under a particular set of conditions. (For example, 5°F. suction vapor and 86°F. condenser.)

Refrigeration compressors are frequently rated in "tons of refrigeration at a certain suction pressure" and this numerical figure is approximately one half of the "horse-power" rating of the motor driving the compressor. However, many engineers find it more satisfactory to list the size of compressor in terms of piston diameter and length of piston stroke, since the following factors affect the size of motor and capacity of a compressor:

a. The refrigerant used. Compressors are made for a particular refrigerant.
b. The diameter of the cylinder. This influences the volume of refrigerant vapor that can be handled at a time.
c. The length of the piston stroke, which also determines the volume of refrigerant vapor handled at a time.
d. The speed, which determines the volume of refrigerant vapor handled per minute, hour, or day.
e. The suction pressure or pressure on the "low side," which determines the weight of refrigerant vapor per volume handled by the cylinders.
f. Volumetric efficiency of machine,—*i.e.,* the ratio between the piston displacement and the actual amount of gas delivered.

The first four of these factors are usually constant in a particular installation, but the capacity of the compressor decreases rapidly with a decrease in the suction pressure. Also it should be remembered that the pressure on the "high pressure side" has almost no influence on the capacity of the compressor, although it does greatly affect the power consumption of the motor

CHAPTER XXI

SOME LABORATORY TESTS OFTEN USED IN ICE CREAM PLANTS

Proper laboratory control is important for efficient operation and for maintaining uniform quality of ice cream. It consists of both chemical and bacteriological analyses of the ingredients used, of the finished product, and of other samples which are taken in the attempt to remedy undesirable conditions. Sometimes arrangements are made with a competent commerical laboratory to make these analyses on the basis of a fixed price per sample, or a flat price per month. However, it is generally desirable and economical to have at least the most essential routine testing done in the plant by its own personnel.

A few of these tests, such as are described later, can be made in a small laboratory containing the simplest and least expensive equipment, and the operator needs only a small amount of specialized training.

TEST FOR FLAVOR AND AROMA

This is perhaps the most essential routine test. It is one of the best and most accurate measures of quality. The aroma (or odor) is best observed in a place where there are no strong odors, and when the observation is made immediately after the sample bottle is opened. The flavor is obtained by taking a small portion (about a teaspoonful) into the mouth, allowing it to warm, and then carefully rolling it to the back of the mouth without swallowing any of it. After the flavor has been observed the portion is delivered into a sink or garbage receptacle instead of being swallowed. Then the next sample may be tested. Care is necessary to avoid contaminating the product.

THE BABCOCK TEST FOR FAT IN MILK

Taking the sample. Whether the sample to be tested is milk, cream, butter, or ice cream, it is equally important that it be taken in such a manner as to make absolutely sure that it is a fair and accurate sample of the product to be tested. Otherwise time and money are wasted in proceeding with the details of the test. Therefore a considerable portion of the product to be tested should be carefully and thoroughly mixed before the sample is taken.

Apparatus and Reagents: Standard Babcock Test Equipment.

Procedure: By means of the 17.6 ml. pipette transfer to the milk test bottle 18 grams of the sample which has been previously cooled to a temperature of 60° to 70° F. and thoroughly mixed, being sure to drain the pipette completely by blowing out the last drop. Add 17.5 ml. com. sulphuric acid, same temperature as above, pouring it down the side of the neck of the bottle in

such a way as to wash any traces of milk into the bulb. Mix the milk and acid thoroughly, first by a rotary motion and finally by vigorous shaking, until all traces of curd have disappeared. Then transfer the bottle to the tester; counterbalance it; and after the proper speed has been attained, whirl for 5 minutes. Add soft water, at 140° F. or above, until the bottle is filled to the neck. Whirl tester again, this time for 2 minutes. Add hot water until the fat is brought well within the scale on the bottle neck. Whirl again, this time for 1 minute. Transfer bottle to a water bath maintained at a temperature of 130° to 140° F. Immerse it to the level of the top of the fat column, allowing it to remain for 5 minutes. Remove bottle from the bath; wipe it; with a pair of dividers measure the fat column, in terms of percentage by weight, from its lower surface to the highest point of the upper meniscus.

At the time of measurement, the fat column should be translucent, of a golden yellow or amber color, and free from visible suspended particles. All tests in which the fat column is milky or shows the presence of curd or of charred matter, or in which the reading is indistinct or uncertain should be rejected.

BABCOCK TEST FOR FAT IN CREAM

Taking the Sample: In collecting the sample of cream the same general procedure is followed as in sampling milk. The cream to be tested should be warmed to a temperature of 100° to 110° F. just before it is mixed. After the cream is warmed it should be thoroughly mixed and all lumps broken up. Precaution should be taken to avoid overheating or allowing the sample to stand too long at 110° F. which would cause it to "oil off."

Apparatus and Reagents: Standard Babcock Test Equipment.

Procedure: Use the cream test scales and weigh 9 grams of prepared sample into a 9-gram cream test bottle, or 18 grams into an 18-gram bottle. Proceed by one of the following methods:

Method 1. After the cream has been weighed into the test bottle, add 8 to 12 ml. of sulphuric acid in the case of the 9-gram bottle, or 14 to 17 ml. in the case of the 18-gram bottle; or add acid until the mixture of cream and acid, after shaking, has assumed a chocolate-brown color. Then shake the bottle with a rotary motion until all lumps have completely disappeared and add 5 to 10 ml. of soft water at a temperature of 140° F. or above. Transfer the bottle to the tester, counterbalance, and after the proper speed has been attained, whirl it for 5 minutes. Add hot water until the fat column is brought well within the graduated scale on the bottle neck. Whirl 1 minute longer. Transfer the bottle to the water bath as in the testing for fat in milk, immersing the bottle to the level of the fat column and allowing it to remain for 5 minutes. Now place 2 or 3 drops of glymol on the surface of the fat column, care being taken to allow the glymol to run down the side of the neck

in order to prevent its splashing and getting beneath the fat column. Remove the bottle from the bath. With the aid of the dividers measure the fat column from its lowest surface to the line of division between the fat column and the glymol.

Method 2. (For use with only the 9-gram bottle.) After the cream has been weighed into the test bottle add 9 ml. of soft water and mix thoroughly; add 17.5 ml. of sulphuric acid and shake with a rotary motion until all lumps have completely disappeared. Transfer the bottle to the tester, counterbalance, and, after the proper speed has been attained, whirl for 5 minutes. Fill the bottle to the neck with hot water and whirl again, for 2 minutes. Add hot water until the fat column is well within the graduated scale on the bottle neck. Whirl for 1 minute longer. Transfer to the water bath and continue as in Method 1.

As in the test for fat in milk, the fat column, at the time of reading, should be translucent, of a golden yellow or amber color, and free from visible suspended particles. All tests in which the fat column is milky or shows the presence of curd or charred matter, or in which the reading is indistinct or uncertain, should be rejected.

BABCOCK TEST FOR FAT IN ICE CREAM

There are a number of modified Babcock Tests for fat in ice cream most of which are quite satisfactory. However, since these tests are somewhat similar, only the Pennsylvania Test will be described.

Preparation of Sample: Melt the ice cream at room temperature, and if necessary, heat to eliminate the foam. Warm ice cream mix to approximately 70° F. Reduce large particles in fruit and nut ice cream to a finely divided state.

Apparatus and Reagents: Regular Babcock equipment and glassware, including ice cream test bottles. Ammonium hydroxide (28—29% NH_3). Correct strength is important. Normal butyl alcohol (B.P. 117° C). Diluted commercial sulphuric acid (approximate specific gravity 1.72—1.74 at 68° F). The acid is prepared by adding 3½ parts, by volume, of commercial sulphuric acid (specific gravity 1.82—1.83) to one part of water in a heat resisting container.

Procedure: Weigh 9 grams of the representative sample into a 9-gram 20% ice cream test bottle, care being taken to keep the fruit or nut ice cream thoroughly mixed. Add 2 ml. ammonium hydroxide (preferably from a burette). Mix for approximately one-half minute. Add 3 ml. of butyl alcohol. Mix for approximately one minute (samples containing chocolate require additional mixing.) Add 17.5 ml. of the diluted sulphuric acid. Mix thoroughly until digestion is completed. Centrifuge the bottles for 5 minutes. Add water (130°-140° F.) to bring the contents to within one-fourth

inch of the base of the neck of the bottle. Centrifuge for 2 minutes. Add enough water (130°-140° F.) to keep the fat within the graduated portion of the neck of the bottle until read. Centrifuge 1 minute.

Place the bottles in a water bath at 130° F. for 5 minutes. Allow a few drops of glymol to run down the inside of the neck of the bottle just before reading. Measure the length of the fat column from the bottom of the lower meniscus to the sharp line of demarcation between the glymol and the fat.

Precaution: The small amount of sample which adheres to the inside of the neck of the bottle should be washed into the bottle by the reagent; otherwise it may collect at the base of the fat column and make the correct reading of the fat column difficult.

THE BABCOCK TEST FOR FAT IN BUTTER

Taking the sample: All that has been said about the need for care in sampling milk applies equally, or even more, to the sampling of butter because the sample must be taken so as to represent the composition of the whole batch to be tested. A butter trier is used to take the samples or "plugs" as they are called, from various places in the butter container, and from top to bottom of the butter in the container. The sample may be prepared in several different ways but the following method is quite generally used: Place the "plugs", as they are taken, in a clean, dry, tightly stoppered sample jar. Warm only enough to soften the butter so that it can be stirred easily. Using an electric food mixer of the double beater type, with shafts attached to a metal screw cover to fit the sample jar, insert the beaters into the jar; screw cover down tight; mix contents at high speed for about three minutes. Rotate the jar until all portions of the contents are incorporated in the mixture. Remove the beater and proceed with test.

Precaution: If for any reason the testing is not done within a few hours, or if the sample has been allowed to become so warm that it melts, re-mix the sample just before the test is to be made.

Apparatus and reagents: Standard Babcock Test Equipment including a 90% Butter Test Bottle.

Procedure: Weigh 9 grams of the prepared sample into the 90% butter test bottle. (Fat clinging to the neck of the bottle may be melted by holding the bottle neck under the warm water tap till the fat melts and runs into the bottle). Add about 9 ml. of the sulphuric acid (sp. g. 1.82—1.83). Mix thoroughly by gently rotating the bottle. Centrifuge and complete the test as described for testing cream.

The Babcock test is not quite as accurate for butter as for cream. It is generally thought to read about one-half per cent too high. There are more

accurate tests such as the "Kohman" and the "Mojonnier" which the operator with more experience may wish to use.

THE ACIDITY TEST FOR MILK

This test is a means of measuring the percentage of acidity in milk.

Taking the Sample: Samples for this test should be taken in the same careful manner as mentioned for fat tests.

Apparatus and Reagents: 17.6 ml. pipette as for the Babcock test; 9 ml. pipette; white porcelain cup; glass stirring rod; burette graduated to read to 0.1 ml.; alkali solution (0.1 normal); indicator (1.0% phenolphthalein).

Procedure: By means of the 17.6 ml. pipette transfer 18 grams of the sample to the white cup. Add three to five drops of the indicator. Then fill the burette with alkali solution, making sure that no air bubbles remain in the tip of the burette when it is filled to the zero mark. Slowly titrate the milk with the alkali solution until a faint pink color appears. (This color should persist for about 30 seconds). Read to the nearest 0.1 ml. the number of milliliters of alkali solution used. Divide the number of millilters of alkali used by 20 to get the percentage of acidity in the milk.

THE ACIDITY TEST FOR CREAM AND PLAIN ICE CREAM MIX

Taking the Sample: Proceed as for testing acidity in milk.

Apparatus and Reagents: The same as for testing acidity in milk.

Procedure: By means of the 9 ml. pipette transfer 9 grams of sample to the white cup. Add 9 ml. of distilled water, and three to five drops of the indicator. Then titrate with the alkali solution as described for milk, and read the number of milliliters of alkali solution used. The percentage acidity is obtained by dividing the number of milliliters used by 10.

TESTING GELATIN

The Dahlberg Test, sometimes called the test-tube test, serves as a guide in determining the amount of gelatin needed in the mix, and in comparing the stabilizing ability of different gelatins when used in ice cream.

Apparatus: Butter moisture scales, or scales of equal accuracy; set of weights, one to 100 grams; a 250 ml. beaker (for weighing skim milk); one-liter Erlenmeyer flask; 2 dozen test tubes—12 to 14 mm. diameter; a test tube rack; 2 pipettes, capacity 10 ml. in 0.1 ml. graduations.

Reagents: Gelatin sample and at least a quart of fresh skim milk.

Procedure: Weigh and put into the flask exactly 495 grams fresh skim milk, below 80° F. Weigh exactly 5 grams gelatin, and add it to the skim milk in the flask, thus obtaining a 1.0% gelatin solution. Allow to soak for 30 min. Then using a water bath, heat the gelatin solution to 145°F. and hold

at this temperature for 15 min., keeping the flask stoppered to prevent evaporation while heating, *etc.* Cool the solution to room temperature. Now put at least ten clean, dry test tubes in a rack, and number them. Then using one pipette for the gelatin-skim milk solution, and another for the fresh skim milk, prepare the following series of solutions:

Tube No.[1]	*Gelatin-Skim milk ml.*	*Skim Milk ml.*	*Factor*
1	10.0	0	1.00
2	9.5	0.5	0.95
3	9.0	1.0	0.90
4	8.5	1.5	0.85
5	8.0	2.0	0.80
6	7.5	2.5	0.75
7	7.0	3.0	0.70
8	6.5	3.5	0.65
9	6.0	4.0	0.60
10	5.5	4.5	0.55
11	5.0	5.0	0.50
12	4.5	5.5	0.45

[1]Additional tubes may be needed for some gelatins.

Mix each tube by inverting it, and then set them in ice water for 18 to 20 hours. Then examine each tube in turn by placing a thumb over the top of the tube and quickly inverting the tube, holding the inverted tube still for 30 sec. Do not allow the hand to warm the tube. Record the number of the tube in which the solution just fails to break when inverted for 30 sec. The "Factor" (the percentage gelatin in the tube) corresponding to this tube is used to calculate the amount of this sample of gelatin needed in an ice cream mix as follows:

Example: To determine the amount of gelatin to use in an ice cream mix containing 36.09% total solids proceed as follows:

$$\% \text{ gelatin in the mix} = \text{Factor} \times \frac{100 - \% \text{ total sol. in mix}}{100 - \% \text{ s. s. in skim milk}}$$

The skim milk used in the gelatin test contained 8.7% serum solid. When the tubes were inverted for 30 sec., the solutions in tubes No. 10 and 11 broke and ran down, but the solution in tube No. 9 failed to break. The factor corresponding to tube No. 9 is 0.60. Therefore,

$$\% \text{ gelatin in the mix} = 0.60 \times \frac{100 - 36.09}{100 - 8.7} = 0.42\%$$ which is the percentage of gelatin to use in this ice cream mix provided no other ingredients used act as a stabilizer.

When using the Dahlberg test to compare different gelatins, the follow-

ing conditions must be kept uniform for all gelatins: (1) the quality, i.e. acidity, of the skim milk; (2) the soaking time, heating time, and temperature in making the solutions; and (3) the temperature and time of the ice water bath.

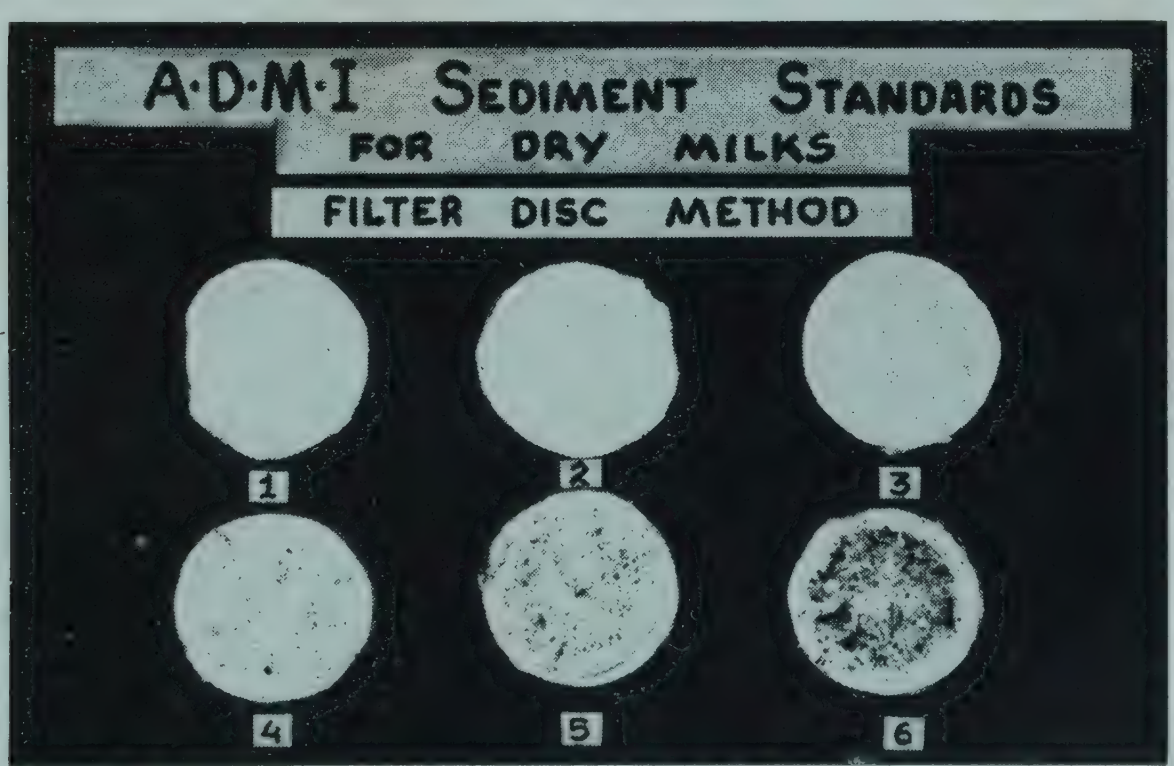
This test is not satisfactory for the gum type of stabilizers. In fact, there is, as yet, no really accurate test of stabilizing ability for either the gelatin type or the gum type of stabilizer.

TESTS FOR AMMONIA LEAKS

Apparatus and Reagents: A clean tumbler; a piece of glass large enough to cover it. Ammonia test papers purchased from refrigeration companies. Similar papers may be prepared from heavy white paper strips (about 1 by 5 inches). These are dipped in phenolphthalein solution (the indicator solution used for acidity tests). If dried and stored for future use these test papers must be moistened with distilled water when used.

Procedure: Pass a strip of the test paper along the ammonia pipes, valves, or compressor head suspected of having leaks. If there is a leak, the phenolphthalein treated paper will turn pink where it comes in contact with the escaping ammonia.

Ammonia leaking into the brine or the cooling water may be detected as follows: Fill a tumbler half full of the suspected brine or cooling water and add about one-eighth teaspoonful of dry caustic soda or lye, whichever



Courtesy, American Dry Milk Institute.

Fig. 41. Sediment Standards can be used for checking for sediment in nonfat milk solids much the same as in milk and cream.

is available. Cover with the piece of glass. Insert right under the cover, but not in the solution, a small strip of the phenolphthalein treated paper. If paper becomes pink after a few minutes it indicates that ammonia has been escaping into the brine or cooling water.

OTHER TESTS USED IN A QUALITY CONTROL PROGRAM

Other chemical tests, and bacteriological tests require more elaborate equipment and a more skilled operator. However, their use is important in any well-organized quality control program. Among these tests are the Mojonnier Test for fat and total solids; the Phosphatase Test now being adopted as a standard for detecting improper pasteurization; the Coliform Test used as a measure of the sanitary handling of dairy products; the Sediment Test used to detect the presence of insoluble foreign matter that does not properly belong in dairy products.

Directions for these and other analytical tests can be found in Standard Methods For The Examination Of Dairy Products published by The American Public Health Association, 1790 Broadway, New York 19, New York; and in Official and Tentative Methods of Analysis published by the Association of Official Agricultural Chemists, Box 290, Pennsylvania Avenue Station, Washington, D. C.

CHAPTER XXII

SALES OUTLETS

In recent years, as competition for ice cream business has become keen, the wise ice cream manufacturer, as a security measure, tries to assure himself of a dependable market for his product. There are several types of market from which he may choose.

1. He may wholesale to drug stores and confectionery stores, to frozen foods stores, and to dairy stores.



Courtesy, United Dairy System.

Fig. 42. Jane Alden. A fine example of the better type of Ice Cream parlor, elaborate in all its appointments. Specializes in serving ice cream and Soda Fountain refreshments. Has ample room so that bridge parties and other types of women's groups can be accommodated by appointment. Located in the immediate vicinity of the leading city park, Springfield, Mass.

2. He may retail directly from his factory to his customers.
3. He may have his own special outlets in the form of ice cream stores. dairy bars, or one of the newer types of drive-in stores, (parlors).

WHOLESALING

If the first type of outlet is chosen, the drug store will usually be a good market for bulk and may carry some packaged ice cream. The frozen food store will be an excellent market for the take home package. In the large cities dairy stores are quite common and usually have developed a reputation for high quality ice cream in addition to other high-quality dairy products such as cottage cheese, other well-cured cheese, dependably good butter. cream, cultured sour milk, etc.

FACTORY RETAILING

Factory retailing has been somewhat facilitated in recent years by the availability, in most commercial centers, of dry ice, and by use of single-service containers and light cardboard packing cases. These conveniences make it possible to use light-weight trucks and side-delivery motorcycles



Courtesy, Friendly Ice Cream Corp. Springfield, Mass.

Fig. 43. One of a chain of Ice Cream Stores serving ice cream, Soda Fountain refreshments and lunches, is located on a prominent highway and has large, paved parking area in front and back. The company plans many more in conjunction with Gas stations.

for making deliveries from factory to consumer and thus reduce expense to some extent.

DRIVE-IN STORE

The main requirement for the drive-in store, second only to the store itself, is, of course, plenty of parking space for customers' cars. If possible the site chosen should have a pleasing background and a good view, and the parking area should be kept neat and tidy. Since it has been estimated that about 75 per cent of ice cream business is in repeat orders, obviously the drive-in store should be on the edge of the residential area and preferably near and in view of a well-travelled highway.

The store itself should be attractive, well-lighted, well-arranged and convenient for service. It should be kept clean and sanitary in every detail, even to toilets for the public and for employees.

The manager of such a store, of any food store, should make it a first rule to become familiar with his state and local community health regulations and



Courtesy, E. L. MacKenzie, Keene, N. H.

Fig. 44. Large parking area is essential for the drive-in type of retail store. This area (175 ft. x 150 ft., capacity 125 cars) is none too large for this modern, well-planned store at present equipped to sell about 50,000 gallons per year.



Courtesy, E. L. MacKenzie, Keene, N. H.

Fig. 45. A modern, modest but skillfully planned drive-in store selling cones, carry-home packages, and fountain service of only dairy products. Customers are served through the five windows at the right, and curb service is supplied by "car-hops" through the door at the far end.

insist that all his employees and persons delivering food products to his establishment comply with such regulations.

THE TAKE-HOME PACKAGE SECTION

Perhaps there is no better way to expand an ice cream business through retail than by encouraging customers to take home a package of ice cream. For quick service have it neatly packaged in pint, quart, and half-gallon sizes of such shapes that they will fit neatly into the consumer's home refrigerator or deep freeze compartment. These packages should be stored in the cabinet ready to be placed in insulated bags to hand to the customer. Promoting take-home packages surely helps to get more people in the habit of eating ice cream oftener. Emphasize again and again how easy it is and how time-saving, to serve ice cream at home as compared with other desserts. Stress the food value and palatability of this truly great American dessert.

THE SODA FOUNTAIN

Soda fountain service is a profitable addition to many of the types of outlet mentioned. However this kind of business should be ventured into only if there is sufficient capital to do a good and attractive job of installation, and only if the management is soda fountain-minded and sufficiently interested to become famliar with the many phases of this kind of merchandising.

If rightly equipped and managed, and staffed with perfectly trained personnel there is no doubt that the soda fountain can be a great help in selling ice cream. Keep in mind, however, that service must be given in an accommodating, eye-appealing and taste-tempting manner. The ice cream dispenser, and the soda fountain itself should have a neat, well-cared-for appearance. Over all and about everything connected with the fountain and its environment there must be that intangible atmosphere which suggests wholesomeness, cleanliness and, sanitation.

General Housekeeping. Both the inside and the outside of the fountain need regular attention both as to cleaning and upkeep. For sanitary reasons, the inside must be kept scrupulously clean. Keeping it clean both inside and outside also retards corrosion of the metal linings and thus prolongs the life of the fountain. Keep in mind too that a spotless general appearance has definite customer appeal and generally pays off handsomely in additional profits.

Glass or Paper Dishes. At the fountain either glass or paper cups and serving dishes may be used. Many people prefer glass serviceware but if it is used great care must be taken to prevent breakage and to keep dishes sanitary. With glass there is also the danger that chips of glass may fall into the open ice cream cans, and there is always the extra work of cleaning dirty dishes. When paper cups and dishes are used, good housekeeping is made easier, the

serving can be more sanitary, and there is no danger of broken glass and no expensive delay for dishwashing.

PERSONNEL

Remember that soda fountain success is quite definitely dependent upon the selection and training of just the right type of personnel for giving good service. This applies equally well to dairy bar or dairy store personnel. The men and women behind the counter should be schooled to follow a well-planned routine regarding the best form of greeting and approach to customers, in taking the order, in serving the food, in making suggestions for increasing the order, in presenting the customer's bill or check, and in cleaning the counter before the next customer is served, etc. In short, the good dispenser, or sales person, will cultivate cheerfulness, meet customers with a **smile,** be dignified and quiet, give quick, accurate and gracious service, and be dependable and honest.

Health Habits. The public is becoming more and more health conscious and therefore persons handling and serving food should be trained to live up to definite and rigid health standards. The hair should be well groomed; women employees should wear hair nets; men should be clean shaven; teeth should be well cared for, hands and fingernails clean and trim; uniforms should be clean and neat and shoes clean and polished. Soap and water should be easily accessible and used as freely as common-sense sanitary regulations dictate.

Keep Hands Clean. "Hands," someone has said, "are the tools of the food worker," essential tools in many operations in filling orders. The following rules about cleanliness of the hands must be observed by all operators: Keep them clean. Always assume they may carry germs. Wash them before handling tableware and food. Wash them after each visit to the lavatory; after coughing or sneezing, or combing the hair; and after handling refuse or waste of any kind. Always be sure they are **clean** before they touch food.

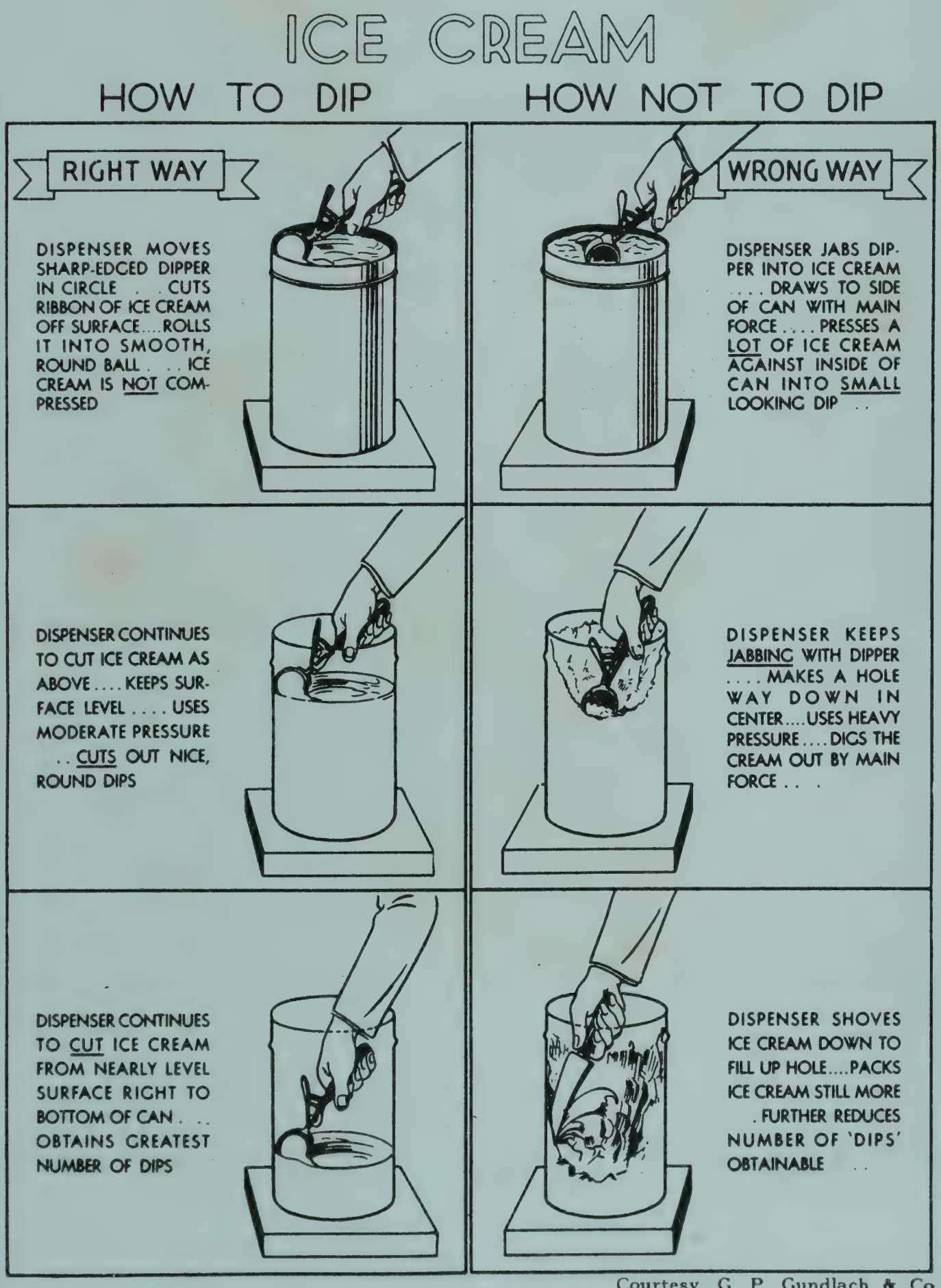
TRAINING FOR FOUNTAIN SERVICE

Quite likely the retailer's principal interest in the soda fountain is to increase his profits. To do this he must have more and more customers. In order to attract customers and have them come back for repeat orders, he must be sure that his ice cream is of high quality, that good cream and good flavoring substances are used in making it, and that equally good quality of syrups and toppings are used to combine with the ice cream at the fountain. Generally it is best to buy and use only the best and most palatable materials for toppings and syrups and then be familiar with the "how" and "when" to use them most effectively. Therefore it would pay the retailer to train his workers so they will sell more ice cream and thereby make larger profits.



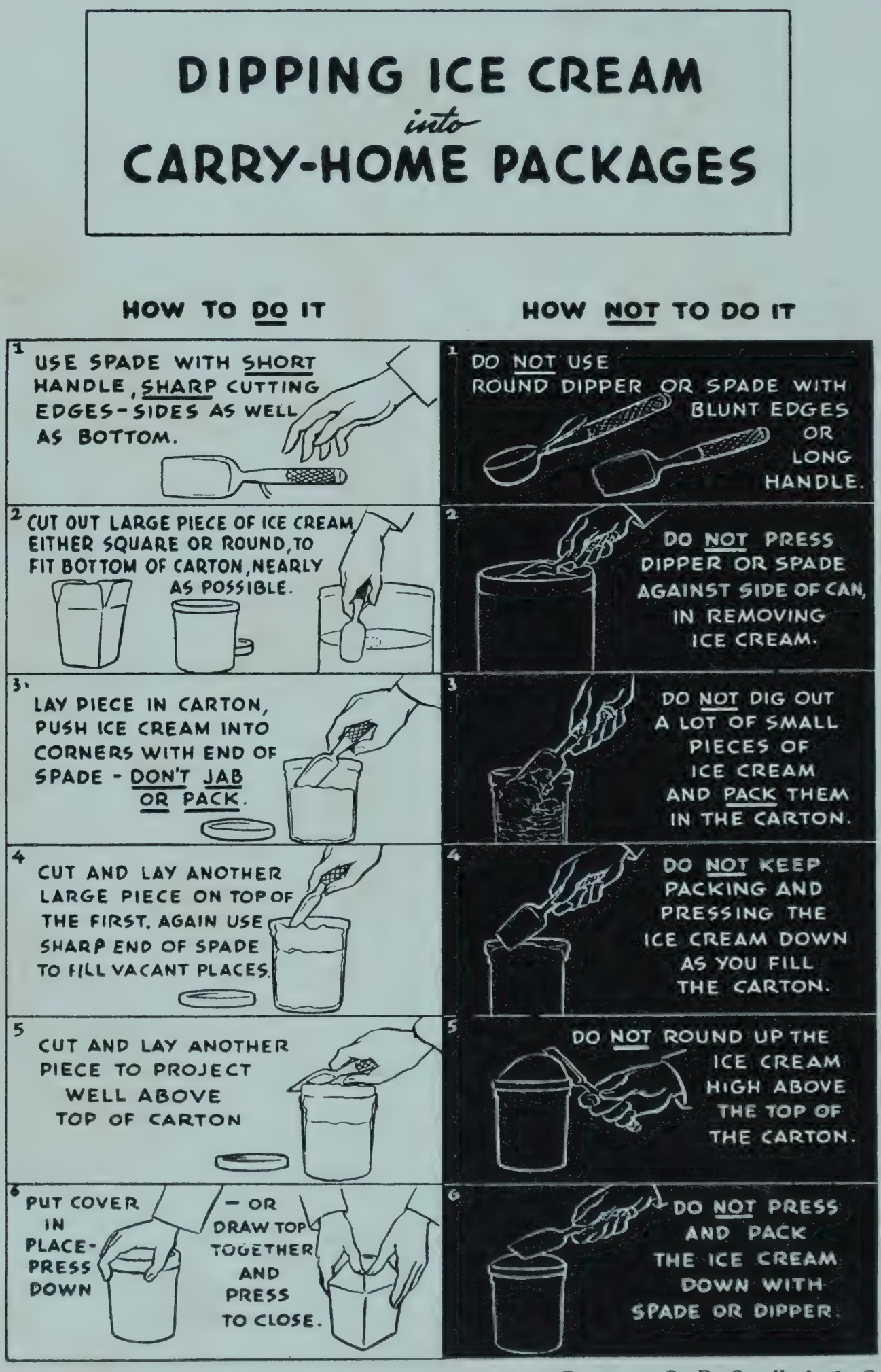
Courtesy, Grand Rapids Cabinet Company

Fig. 46. A modern Soda Fountain installation including wall fountain, liberal ice cream storage facilities, and low temperature display and storage case in which frozen ice creams can be displayed unwrapped, in all their attractiveness; a very effective sales medium.



Courtesy, G. P. Gundlach & Co.

Fig. 47. Ice Cream—How To Dip



Courtesy, G. P. Gundlach & Co.

Fig. 48. Dipping Ice Cream into Carry Home Packages

The dispenser, the man in charge of the fountain, should have some special training in soda fountain work until he has thoroughly mastered the "know-how" of what and how to serve. He should be familiar with the best methods of preparing toppings and of blending fruits, nuts, and toppings with simple syrups. He should also know how to dip ice cream most economically, and know the most attractive ways in which the variously colored and flavored ice creams should be served.

How to dip ice cream. While it may seem like an easy thing to do it really takes practice and planning to dip ice cream properly. To lower the ice cream surface evenly in the can, to cut from the highest surface of the ice cream, and to keep the can stationary while dipping the ice cream for the cone, requires skill that comes only with practice. Experienced fountain operators (dispensers) have found that it is best to press the ball of ice cream gently on the side of the cone with outside of the dipperbowl, pressing just enough to make it stick but not enough to spoil its shape or to break the cone. The dispenser should learn early at what temperature ice cream will dip or cut easily and still not be so soft as to spoil the texture and cause shrinkage. He will get this "feel" for dipping only by practice.

Employees as Sales Representatives. The men and women employed for fountain service are the principal contact the retailer has with the public who buy his products. It is really a waste of money to advertise, build and equip a fine building, and manufacture or buy high quality ice cream if the employees who represent the establishment are sloppy, or lazy, or if in general, they create an unfavorable impression on the public—the consumer who is counted upon to buy this delicious product.

All that has been said about employees' training, ability, and qualifications has been said simply to emphasize the fact that these employees really reflect the business and managerial ability of the proprietor. If he is a good manager his business should prosper. In case the business is larger than he can handle personally, much will depend on the store or fountain manager he chooses to help run the business for him.

Choosing a Manager. The manager should be chosen with great care—not on the spur of the moment. His references should be carefully checked to make sure that he is all he represents himself to be. As a guide in checking his qualifications the following suggestions may be helpful: he must be honest; be conscientious; be able to handle personnel, to work with them and yet be their leader; he must be efficient in the duties he is hired to perform and have some administrative ability; he must have enough originality to be able to develop new sales ideas; and finally he must be 100 per cent loyal to the proprietor or organization which hires him. When the person with the right qualifications has been found, he should be paid what he is worth, his boss

should back him up to the nth degree, and see that life is made pleasant for him especially until he is thoroughly initiated into his new job.

If the staff of store and fountain is to "click" as would be expected in a well-integrated organization, training for the job is necessary for all employees. The work expected of them should be carefully explained, better still, ably demonstrated to them. Employees should be given a chance to ask questions and these questions should be very patiently answered so that the employee will thoroughly understand his work and that of the others with whom he must work.

The management which has thus thoroughly trained its representatives, *i.e.,* its employees, for their respective jobs, should be well on the way toward a profitable business.

"SPECIALS" FOR SPECIAL OCCASIONS — SEASON MINDED

One of the best ways of promoting sales is by featuring "specials" and being "season-minded" about them. Some especially appetizing and attractive reminders of Spring when Winter is about to take leave and equally attractive features for the other seasons will tempt the public to choose ice cream more often. There are many special days in every season which will suggest to the imaginative ice cream maker or soda fountain dispenser new ideas for taste-tempting formulas and decorative schemes. The variety thus introduced will make his product so attractive that sales are bound to mount. He must, of course, not only make these specials but see to it that they are well advertised so the public will know about them well in advance of the special day that is featured. For instance, consumers should know well in advance of Easter what attractive special ice creams they may have for dessert and for decorating effects for that special day. So, with Fourth of July, World Series days, Thanksgiving, Christmas Day, New Years, and Valentines Day, to name only a few. Then there are birthday specials and anniversary specials to fit the season in which such family or club events occur. All these should be very good sales outlets for the manufacturer who is looking for extra business. (See Chapter XVI, Fancy Molded Ice Creams, Novelties, and Specialties.)

CHAPTER XXIII

FORMULAS FOR SODA FOUNTAIN USE

From George W. Hennerich's[a] excellent book, "Let's Sell Ice Cream", we are quoting by permission certain definitions of Soda Fountain Terms, and Soda Fountain Formulas. In this book Mr. Hennerich offers valuable detailed information not only regarding the many and varied combinations of Ice Cream and Toppings used to produce the sundaes and other specialties which have helped many to secure added business, but has also suggested the type of glassware and the quantity of each ingredient. Your own serviceware, either glass or paper, may of course be substituted. He stresses the importance of putting the various ingredients into the glass or paper service in the order listed.

SODA FOUNTAIN TERMS

Following are a few of the most commonly used Soda Fountain Terms. The ambitious dispenser should lose no time in acquiring a handy reference book giving full details of this phase of his work.

Ades—Drinks containing the juice of citrus fruits, sweetened, to which plain or carbonated water is added.

Baumé Hydrometer—Used to determine the degree of sugar concentration in simple syrup.

Bon-Bon—Similar to a sundae. Usually made in a 6 or 7 ounce fancy stem glass. Candied fruit in the bottom of glass, a combination of Ice Cream, Sherbet, flavor or fruit.

College Ice—This name was given to a sundae in a college town and was originally applied to sundaes topped with whipped cream.

Cooler—A drink made of fruit or fruit flavors in combination with ice, carbonated or plain water and topped with sherbets. Frequently made up complete and dispensed from punch bowl, adding ice and sherbet.

Double Sundae—The same flavor Ice Cream and same flavor topping—as for example Chocolate Ice Cream and Chocolate topping.

Egg Phosphate—A glass of carbonated water in which have been scientifically blended flavor, acid phosphate and an egg.

Fizz—Originally applied to tart drinks to which were added powdered sugar to give the fizzing effect. This name is applied to many egg drinks.

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[a] Managing Director of The Ice Cream Merchandising Institute, Inc., Washington, D. C., Affiliate of The International Association of Ice Cream Manufacturers.

Float—An ade, freeze, ricky, milk shake or other drink on the top of which fruit ice, sherbet or Ice Cream is floated.

Frappé—Frozen or partly frozen fruit juices. It is applied to whipped combinations of Ice Cream—syrup—fruits—nuts and whipped cream.

Frosted Chocolate—Another name for a chocolate milk shake made with Ice Cream.

Frosty—A milk shake made with sherbet or fruit ice.

Glacé (glă-say)—Frozen or iced fruits, nuts, etc. Drinks with an overlay of fruits or nuts, usually made very cold with ice. Also applied to sundaes on which glossy surfaced fruits and sugared nuts are served.

Ice Cream Soda—A combination of fruit syrup or other flavor, Ice Cream and carbonated water.

Royal—Applied to unusual Ice Cream combinations—generally those in which sliced fruit covers the bottom of the dish, and is topped with Ice Cream, fruits, toppings, nuts, etc.

Shakes—Originally applied to any drink that was shaken to mix it. Now applied to milk drinks made with Ice Cream, and mixed on drink mixer.

Soda—Usually accepted at the Soda Fountain to mean Ice Cream Soda.

Sundae—A portion of Ice Cream over which one or more dressings of syrups, fruits, nuts, or other toppings are poured.

Twin Sundae—A two-in-one method of making a sundae. Two molds of Ice Cream alongside one another in the same dish and topped with the usual sundae materials.

FORMULAS

SUNDAES AND SPECIALS

American Beauty

(flat or footed round dish)

1 #10 dipper Vanilla Ice Cream
1 oz. Chocolate Fudge
5 stem Whole Maraschino Cherries

Sprinkle chopped nuts over fudge. Garnish with a straight line of whipped cream through center and sprinkle chocolate decorettes over all.

Balloon

(tulip glass)

½ oz. Chocolate Sauce
2 #20 dippers Vanilla Ice Cream
1 oz. Chocolate Sauce

Top with whipped cream and a cherry.

Note: Use the "give-away balloon" idea with this sundae.

Banana Whip

(stem sundae dish)

2 #20 dippers Chocolate Ice Cream

Sliced Banana—to cover

Top with a generous portion of whipped cream and a cherry.

Bee-Hive
(tulip glass)
½ oz. Pure Honey
2 #20 dippers Vanilla Ice Cream
1 oz. Pure Honey
Over the top sprinkle a portion of fresh crunchy roasted salted almonds. Garnish with whipped cream and a red cherry.

Birthdae
(tulip glass) (for February 12)
½ oz. Log Cabin or Maple Syrup
2 #20 dippers Chocolate Ice Cream
1 oz. Log Cabin Syrup
Two pretzel sticks on each side of dish to form a sundae. Top with cherry.

Black Cherry Sundae
(tulip glass)
½ oz. Burgundy Cherries
2 #20 dippers Vanilla Ice Cream
1 oz. Burgundy Cherries (over Ice Cream)
Decorate with whipped cream.

Blueberry Banana
(tulip glass)
½ oz. Fresh Blueberries
2 #20 dippers Vanilla Ice Cream
1 oz. Fresh Blueberries
Decorate with whipped cream and sliced banana around edge of glass. Top with a whole blueberry.

Brandi-Peach
(stem glass or paper service)
1 #12 dipper Vanilla Ice Cream
1 oz. Brandi-Peach
Border of whipped cream around edge of dish
Place a date on each side and English walnut halves between each date. Place a whole cherry in center.

Budget Chocolate
(paper cup)
1 #16 dipper Vanilla Ice Cream
1 oz. Chocolate Syrup
Garnish with whole or half Maraschino Cherry.

Butterscotch Peanut Royal
(ice cream bowl or round dish)
Slices of Banana (to cover bottom of dish)
2 #20 dippers Butterscotch variegated Ice Cream
1½ oz. Butterscotch (between molds)
Top with blanched salted peanuts.

Caramel Crunch
(crimp or tulip glass)
½ oz. Caramel Topping
2 #20 dippers Vanilla Ice Cream
1 oz. Caramel Topping
Grape Nuts or Chopped Nuts
Top with a cherry.

Chocolate Brownie
(tulip glass)
1 #20 dipper Chocolate Ice Cream
Crumbled Chocolate Brownie
1 #20 dipper Chocolate Ice Cream
The other half of a Chocolate Brownie crumbled over it
Whipped Cream, Red or Green Cherry
Serve with a whole chocolate brownie on the underlying plate.

(tulip glass)
½ oz. of Marshmallow Topping
1 #20 dipper Chocolate Ice Cream
1 #20 dipper Vanilla Ice Cream
1 oz. Chocolate Topping
1 spoon Salted Peanuts over topping.

Chocolate Rice Krispies
(tulip glass)
½ oz. Chocolate Topping
2 #20 dippers Vanilla Ice Cream
1 oz. Chocolate Topping and a good portion of Rice Krispies.
Garnish with whipped cream and a cherry.

Christmas Fountain Special
(tulip glass)
2 #20 dippers Chocolate Ice Cream
Small portion of Special Christmas whipped cream dressing
Garnish with whipped cream and red and green cherries or red and green pineapple cubes.

Co-ed Special
(tulip glass)
½ oz. Chocolate Topping
2 #20 dippers Vanilla Ice Cream
½ oz. Chocolate Topping
½ oz. Marshmallow Topping
4 slices of Banana around the outside
Whipped cream and cherry.

Coffee and Cream
(tulip glass)
½ oz. Coffee Syrup
2 #20 dippers Coffee or Vanilla Ice Cream
1 oz. Coffee Syrup
Garnish with whipped cream and a cherry.

Cold Fudge Baby Ruth
(stem glass or paper service)
1 #12 dipper Vanilla Ice Cream
1 oz. Cold Fudge
1 small Baby Ruth Bar
Garnish with whipped cream and a slice of the bar.

Double Feature Strawberry
(banana split dish)
2 #20 dippers Strawberry or Vanilla Ice Cream (side by side)
1½ oz. Fresh Frozen or Preserved Strawberries over both molds
Whipped Cream between the 2 molds
Whole Strawberry on whipped cream.

Double Raspberry
(crimp glass)
½ oz. Fresh Red Raspberry Topping
2 #20 dippers Raspberry Ice Cream
1 oz. Fresh Red Raspberry Topping
Garnish with whipped cream and a red cherry.

Egg Nog No. 1
(tulip glass)
½ oz. Crushed Pineapple
2 #20 dippers Egg Nog Ice Cream
1 oz. Crushed Pineapple

(Contd. next page.)

Garnish with whipped cream and a cherry.

Frosted Frutti
(tulip glass)

½ oz. Fresh Fruit Salad
1 #20 dipper Vanilla Ice Cream
1 #20 dipper Strawberry Sherbet or Fruit Ice
1 oz. Fresh Fruit Salad
Top with a soda spoon of strawberry sherbet or fruit ice and imbed a red cherry in the center.

Fruited Strawberry
(tulip glass)

½ oz. Crushed Strawberries
2 #20 dippers Vanilla Ice Cream
1 oz. Crushed Strawberries
Top with a whipped cream ring and one whole strawberry.

Georgia Peach
(crimp glass)

½ oz. Crushed Peaches
2 #20 dippers Vanilla Ice Cream
1 oz. Crushed Peaches
Garnish with whipped cream and a peach slice.

Peanut Brittle Sundae
(crimped dish)

½ oz. crumbled Peanut Brittle
2 #20 dippers Vanilla Ice Cream
Cover with 1 oz. crumbled Peanut Brittle.

Touch Down
(crimp glass)

1 chocolate covered Brazil Nut
1 No. 16 dipper Butter Pecan Ice Cream
1 oz. heavy Coffee Syrup
Garnish with Whipped Cream
Top with a Red Cherry

(Note: The chocolate covered Brazil nut is intended to represent the football; and, when the patron eating the sundae reaches the bottom of the glass, he has "made a touchdown.")

Valentine
(tulip glass)

½ oz. Crushed Strawberries
2 #20 dippers Vanilla Ice Cream
1 oz. Crushed Strawberries
Top with whipped cream and decorate with 5 or 6 heart shaped candies or make your regular strawberry sundae, and after adding the whipped cream, decorate with 5 or 6 heart shaped candies.

Cherry Fudge (Hot)
(twin sundae dish)

1 #20 dipper Vanilla Ice Cream
1 #20 dipper Coffee Ice Cream
1 oz. Hot Burgundy Cherries over the Vanilla Ice Cream
1 oz. Hot Fudge over the Coffee Ice Cream
Garnish with whipped cream and a cherry.

ICE CREAM SODAS

Apple Blossom

1½ oz. Apple Syrup
1 soda spoon of Whipped Cream or Ice Cream or 1½ oz. Coffee Cream
Carbonated Water 3/4ths full
2 #24 dippers Vanilla Ice Cream
Carbonated water to fill if needed

(Contd. next page.)

Garnish with a spoon of whipped cream and a strip of fresh apple.

California

¾ oz. Pineapple syrup
¾ oz. Orange syrup
1 soda spoon Ice Cream or Whipped Cream or 1½ oz. Coffee Cream
Carbonated water 3/4 full
1 #24 dipper Orange Sherbet
1 #24 dipper Vanilla Ice Cream
Carbonated water to fill if needed
Garnish with whipped cream and half slice of fresh orange.

Cherry Blossom

1½ oz. Cherry Syrup
1 soda spoon of Ice Cream or Whipped Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
2 #24 dippers Vanilla or Cherry Ice Cream
Small amount of Crushed Cherries to side of glass
Carbonated water to fill if needed. Garnish with whipped cream.

Chocolate Malted

1½ oz. Chocolate Syrup
½ soda spoon malted milk powder
1 spoon Whipped Cream or Ice Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
2 #24 dippers of either Vanilla or Chocolate Ice Cream
Carbonated water to fill if needed
Garnish with whipped cream.

Frosted Root Beer or Black Cow

1½ oz. Root Beer Syrup
1 soda spoon Ice Cream or Whipped Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
2 #24 dippers Vanilla Ice Cream
Carbonated water to fill if needed.
Garnish with whipped cream

Mocha

¾ oz. Coffee Syrup
¾ oz. Chocolate syrup
1 soda spoon Whipped Cream or Ice Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
2 #24 dippers Chocolate or Coffee Ice Cream
Carbonated water to fill if need ed. Garnish with whipped cream.

Orange-Pineapple

1½ oz. of Orange Syrup
1 soda spoon Ice Cream or Whipped Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
Pineapple or Orange-Pineapple Ice Cream
Carbonated water to fill if needed
Garnish with whipped cream.

Strawberry Frosted

1½ oz. Strawberry syrup (or crushed Strawberries)
1 soda spoon Ice Cream or Whipped Cream or 1½ oz. Coffee Cream
Carbonated water 3/4ths full
1 #24 dipper Strawberry Fruit Ice or Sherbet

(Contd. next page.)

1 #24 dipper Strawberry Ice Cream (or Vanilla Ice Cream)

Carbonated water to fill if needed. Garnish with whipped cream.

MILK DRINKS

Black Cow or Root Beer

6 oz. cold Pasteurized Milk
2 #24 dippers Vanilla Ice Cream
1½ oz. Root Beer Syrup

Blend thoroughly on mixer. Serve in tall thin glass, with cookies at side.

Cherry

6 oz. cold Pasteurized Milk
2 #24 dippers Vanilla Ice Cream
1½ oz. Cherry Syrup

Blend well on mixer, serve in a thin shell glass, with mixing cup on side for overpour.

Chocolate Milk Shake

2 tsp. Cocoa or Chocolate Syrup
¾ cup Milk
Scant tsp. strong Coffee

Mix, beat well, and chill. Serve in glass and top with whipped cream and a dash of nutmeg or cinnamon. Must be ice cold.

Lemo-Lac

This very refreshing and nutritious drink is made by adding sugar and lemon juice to buttermilk or cultured buttermilk. Slightly more sugar and lemon juice are necessary than in making ordinary lemonade and the mixture should be well iced. It is a fine drink for hungry, thirsty folk on a hot day. Try it with your lunch.

Milk Julep

1 Egg
1 tbs. Sugar
Salt (pinch)
1 cup Milk
½ tsp. Vanilla
1 small scoop Ice Cream

Beat the egg until light. Add the sugar; beat the mixture, and add milk, flavoring and salt. Mix or shake well, and chill. When ready to serve, beat or shake until foamy and add small scoop desired flavor ice cream.

Many variations in flavor may be made by adding chocolate syrup, sprays of mint, cinnamon, or a teaspoon of caramel syrup in place of the vanilla.

Milk Scotch High Ball

6 oz. cold Pasteurized Milk
2 #24 dippers Vanilla Ice Cream
1½ oz. Butterscotch Syrup

Place on mixer and mix thoroughly. Add just enough fine stream carbonated water to partially carbonate the entire drink. Serve in thin glass with two scotch wafers.

Mocha Milk Shake Float

3 oz. freshly made double strength Coffee
3 oz. freshly made Cocoa (made with Milk)
2 scoops Cracked Ice

(Contd. next page.)

2 #24 dippers Coffee or Chocolate Ice Cream

Blend on mixer. Pour into a thin shell glass and top with 1 #24 dipper of Chocolate Ice Cream.

Pineapple Buttermilk

6 oz. cold Cultured Buttermilk
2 #24 dippers Vanilla Ice Cream
2 oz. Pineapple Juice (canned)

Place on mixer until well blended. Serve in tall glass, with mixing cup at side.

Spiced Milk

2 cups Sweet Milk
2 tsp. Sugar
⅛ tsp. Nutmeg
⅛ tsp. Cloves
⅛ tsp. Cinnamon
Few grains salt

Heat milk in double boiler. Blend sugar, spices and salt. Add to the hot milk. Beat until spices blend and then chill and serve. Add small scoop of vanilla ice cream to each serving.

TOPPINGS

Bittersweet Chocolate Topping

3 lb. Glucose
1 lb. Cocoa
1 gal. Condensed milk

Cook to good boil and when off fire add 5 lb. marshmallow or nougat cream.

Ritzy Rich Chocolate Topping

1¼ lb. Mild Bittersweet Cocoa
5 pints Milk
6 lb Sugar
¼ teaspoon Salt

Mix cocoa and sugar together dry. Put salt in milk and bring to boiling point. Gradually work in the cocoa-sugar mixture. Bring to boiling point, stirring constantly and boil about two minutes. Turn off heat, strain, put in covered container and cool rapidly.

Swiss Chocolate Topping

2 lbs. XXXX Confectioner's Sugar (powdered sugar)
6 oz. Van Houten or Rona Cocoa
1 pint Coffee Cream

Roll the powdered sugar and cocoa on a flat surface, preferably a cutting board covered with wax paper, until all the lumps in the sugar have disappeared. Add to this 1 pint regular coffee cream. Whip with egg whipper until perfectly smooth. Add ½ teaspoon vanilla extract and whip again.

Orange Pineapple Topping

Blend equal portions orange marmalade and simple syrup. Add 1 part prepared orange marmalade to 2 parts crushed pineapple topping or canned crushed pineapple.

Fudge Mallow

Fudge Mallow is made by blending together two portions of Chocolate fudge topping to one portion Marshmallow Creme. Place in the fudge warmer and serve hot.

Maple Mallow

To 1 qt. of Marshmallow Creme, add ¼ oz. good quality Maple Extract; whip the flavor thoroughly into the marshmallow.

Raspberry Mallow

1 pt. Crushed Black Raspberries
1 qt. Marshmallow Creme

Beat until well blended, stir well before use.

SYRUPS

Simple Syrup[a] (30° Baumé)

5.8 pounds sugar
75 oz. (4.7 lb.) water

Heat to dissolve. Do not boil. Makes 1 gallon syrup.

Simple Syrup—Practical Recipe for 10 Gallons

65 pounds sugar
35 pounds water

Dilute with water to Baumé degree desired.

Recipe for 32° Baumé Syrup

6.25 pounds sugar
4.3 pounds water.

Almond Syrup

Into a gallon of simple syrup put 2 ounces of almond extract. Stir thoroughly.

Bittersweet Chocolate Syrup

1¼ lb. Cocoa
2 qt. Water
5 lb. Sugar
½ tsp. Salt

Mix cocoa and sugar together dry. Put salt in water and bring to boiling point. Add cocoa-sugar mixture and again bring to boiling point. Turn off heat, whip smooth, strain, pour into covered container and chill rapidly.

Chocolate Syrup (heavy)

2 lb. high quality Cocoa
12 lb. Sugar
½ gal. Milk
½ gal. Water
1 level teaspoon Salt

Mix cocoa and sugar together dry. Put salt in water, add the milk, and bring to boiling point. Gradually work in the cocoa-sugar mixture and bring back to boiling point, stirring constantly. Turn off the heat, whip smooth, add 1 ounce vanilla extract, strain, put in covered container and cool rapidly.

Coffee Syrup

5 qt. Water
1½ lb. Coffee
Pinch of Salt
10 lb. Sugar (white and brown half and half)

Have coffee ground fine. Place coffee in a drip funnel. Bring water to a boil—pour over coffee and let seep through. Add sugar and salt while coffee extract is warm. Will finish about 7 qt.

Lemon Syrup

1 ounce Lemon Extract
2½ oz. Citric Acid Solution (50%)
¼ ounce Yellow Color, liquid
1 gallon Simple Syrup 32°

[a] See Chapter XXIV, Table 31 and 32

Orange Syrup

1 ounce Orange Extract
2 oz. Citric Acid Solution (50%)
¼ oz. Orange Color, liquid
1 gallon Simple Syrup 32°

Pineapple Syrup

3 ounces Pineapple Extract
2 oz. Citric Acid Solution (50%)
¼ oz. Yellow Color, liquid
1 gallon Simple Syrup 32°

Raspberry Syrup

3 oz. Raspberry Extract
2 oz. Citric Acid Solution (50%)
½ oz. Red Color, liquid
1 gallon Simple Syrup 32°

Root Beer Syrup (Creamy)

4 oz. No. 9 or No. 11 Root Beer Flavor
¼ ounce Citric Acid Solution (50%)
1 gallon Simple Syrup 32°

CHAPTER XXIV

REFERENCE MATERIAL

WEIGHTS, MEASURES, AND OTHER TABLES, LEGAL STANDARDS AND PLANT INSPECTION FORM.

TABLE 31. HOW TO MAKE SUGAR SOLUTIONS AND DETERMINE THEIR CONCENTRATION BY USE OF THE BAUMÉ AND BRIX HYDROMETERS[1]

Degrees Baumé[2] *M-145 68° F.*	*Degrees Brix 68° F.*	*Weight per gal. in air 68° F.*	*Pounds sugar per gal.*	*Pounds water per gal.*
30.0	55.2	10.50	5.80	4.70
30.5	56.2	10.54	5.92	4.62
31.0	57.1	10.59	6.05	4.54
31.5	58.1	10.64	6.18	4.46
32.0	59.1	10.68	6.31	4.37
32.5	60.0	10.73	6.44	4.29
33.0	61.0	10.78	6.58	4.20
33.5	62.0	10.83	6.71	4.12
34.0	63.0	10.88	6.85	4.03
34.5	63.9	10.92	6.98	3.94
35.0	64.9	10.97	7.12	3.85
35.5	65.9	11.02	7.26	3.76
36.0	66.9	11.07	7.41	3.66
36.5	67.9	11.13	7.56	3.57
37.0	68.9	11.18	7.70	3.48
37.5	69.9	11.23	7.85	3.38
38.0	70.9	11.28	8.00	3.28
38.5	71.9	11.33	8.15	3.18
39.0	72.9	11.39	8.30	3.09
39.5	73.9	11.44	8.45	2.99
40.0	74.9	11.49	8.61	2.88

[1] This table is based on information given in U. S. Bureau of Standards Circular No. 375, Table 1.

[2] Baumé degree equals 145 minus 145 over Sp. Gr.
Specific Gravity equals 145 over 145 minus Baumé reading.

HOW TO USE TABLE 31

EXAMPLE I. Required to make 50 gallons of 30° Baumé sugar syrup.

FORMULA: Read directly from the table the Baumé degree and the pounds of sugar and pounds of water needed to make 1 gallon of that

degree syrup. Note also the weight per gallon of syrup. Multiply each of these amounts by the number of gallons to be made.

SOLUTION (for 30° Baumé): 5.80 × 50 = 290 lb. sugar needed; 4.70 × 50 = 235 lb. water needed; 10.50 × 50 = 525 total weight in pounds of 50 gallons 30° Baumé syrup.

EXAMPLE II. To find the pounds of water required to dilute 1 gallon of 34° Baumé syrup to 30° Baumé syrup.

FORMULA:

$$\frac{\text{(lb. water per gal. diluted syrup)} \times \text{(lb. sugar per gal. original syrup)}}{\text{lb. sugar per gal. diluted syrup}} - \text{(lb. water per gal. original syrup)} = \text{lb. water required.}$$

SOLUTION: From the table substitute figures in the formula thus:

$\frac{4.70 \times 6.85}{5.80} - 4.03 = 1.52$ lb. water required to dilute 1 gallon 34° Baumé syrup to 30° Baumé. For any larger quantity multiply 1.52 by the number of gallons to be diluted.

EXAMPLE III. To find the amount of sugar required to thicken 1 gallon of 30° Baumé syrup to 34° Baumé.

FORMULA:

$$\frac{\text{(lb. sugar per gal. thickened syrup)} \times \text{(lb. water per gal. original syrup)}}{\text{lb. water per gal. thickened syrup}} - \text{(lb. sugar per gal. original syrup)} = \text{lb. sugar to be added.}$$

SOLUTION: From table substitute figures in the formula thus:

$\frac{6.85 \times 4.70}{4.03} - 5.80 = 2.19$ lb. sugar to be added to 1 gal. 30° Baumé syrup to thicken it to 34° Baumé. For any larger quantity multiply 2.19 lb. by the number of gal. to be thickened.

TABLE 32. FOUNTAIN SYRUP MANUFACTURE — BASED ON SIZE OF BATCH WANTED

	1 Gallon Batch			*10 Gallon Batch*		
	Sugar		*Water*	*Sugar*		*Water*
Baumé	*Lb.*	*Oz.*	*Oz.*	*Lb.*	*Oz.*	*Gal. Oz.*
30°	5	13	72	58	....	5 80
31°	6	....	69	60	8	5 48
32°	6	5	67	63	8	5 32
33°	6	9½	64	66	....	5 ....
34°	6	14	69	69	....	4 96

TABLE 32. CONTINUED — BASED ON USE OF 100 POUNDS OF SUGAR

Baumé Wanted 77° F.	*Weight Sugar Taken*	*Amount Water To Add 77° F.*	*Amount Syrup Made 77° F.*
34°	100 lb.	6 gal. 119 oz.	14 gal. 61 oz.
33°	100 lb.	7 gal. 68 oz.	15 gal. 8 oz.
32°	100 lb.	8 gal. 23 oz.	15 gal. 84 oz.
31°	100 lb.	8 gal. 111 oz.	16 gal. 47 oz.
30°	100 lb.	9 gal. 74 oz.	17 gal. 10 oz.

TABLE 33. FOUNTAIN SYRUP DILUTION — BASED ON USE OF ONE GALLON OF SYRUP

EXAMPLE IV. Find Baumé of syrup wanted in extreme left-hand column. Read across to column beneath Baumé of syrup to be diluted. The figure given is the amount of water, in fluid ounces, to be added to one gallon of syrup.

Baumé of Syrup Wanted	*Baumé of syrup to be diluted*				
	30°	31°	32°	33°	34°
30°	.....	6	11½	17½	23½
31°	.....	.....	6	11½	17
32°	.....	.....	.....	5½	11
33°	.....	.....	.....	.....	5½

WEIGHT, MEASURE, AND FOOD SOLIDS IN VARIOUS ICE CREAMS

All foods contain water, and everything not water is called a "solid."

In producing ice cream having certain characteristics, as for example, weighing so much per gallon or quart, or having certain volume per unit of weight, or certain food solids per gallon, and having at all times 12% fat, the relationships in Tables 34 and 35 will be helpful.

A mix of 31% to 48% total solids, having the weights per gallon as shown, then made to take on 100% overrun, or to have 1.6 pounds of food solids per gallon, or to weigh 4.25 pounds per finished gallon, will give the figures shown in Table 35.

TABLE 34. WEIGHT PER GALLON OF FINISHED ICE CREAM, WITH VARIOUS WEIGHTS PER GALLON OF MIX, AND VARIOUS PERCENTAGES OF OVERRUN

Mix	*Percentage of Overrun*																
Lb.	50%	60%	70%	75%	80%	85%	90%	95%	100%	105%	110%	115%	120%	125%	130%	135%	140%
Per Gal.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
8.75	5.80	5.47	5.15	5.00	4.86	4.73	4.60	4.48	4.38	4.27	4.17	4.07	3.98	3.88	3.80	3.72	3.65
9.00	6.00	5.63	5.29	5.14	5.00	4.86	4.74	4.63	4.50	4.39	4.29	4.19	4.09	4.00	3.91	3.38	3.75
9.25	6.17	5.78	5.44	5.29	5.14	5.00	4.85	4.74	4.62	4.51	4.40	4.30	4.20	4.11	4.02	3.93	3.85
9.50	6.33	5.94	5.59	5.43	5.28	5.14	5.00	4.97	4.75	4.63	4.52	4.41	4.32	4.22	4.13	4.04	3.96
9.75	6.50	6.09	5.74	5.57	5.42	5.27	5.13	5.00	4.87	4.76	4.64	4.53	4.43	4.33	4.24	4.15	4.06

TABLE 35. RELATION OF FACTORS

The Mix			*When Yield is 100%*		*When Food Solids Per Gal. is 1.6 lb.*		*When Weight Per Gal. is 4.25 lb.*	
% Total Solids	*Wt. Per Gal. lb.*	*Lb. Total Solids Per Gal.*	*Wt. Frozen lb.*	*Food Solids lb.*	*Yield %*	*Wt. Frozen lb.*	*Yield %*	*Food Sol. lb. Per Gal.*
21	8.92	2.77	4.49	1.39	73.1	5.20	109.8	1.32
31	8.95	2.95	4.49	1.62	84.4	4.85	110.5	1.40
36	8.98	3.23	4.49	1.71	102.0	4.45	110.0	1.53
38	9.00	3.42	4.50	1.85	114.0	4.21	111.8	1.62
40	9.03	3.61	4.52	1.88	126.0	4.01	112.6	1.70
42	9.07	3.81	4.53	1.90	138.1	3.81	113.4	1.79
46	9.14	4.20	4.57	2.10	162.5	3.48	115.0	1.96
48	9.16	4.40	4.58	2.20	175.0	3.33	115.4	2.04

TABLE 36. COMPOSITION, RELATION, AND WEIGHTS OF MILKS AND CREAMS

Fat %	*Solids-Non-fat %*	*Total Solids %*	*Ratio Fat To Solids-not-fat*	*Fat, % of Total Solids*	*Specific Gravity at 68° F.*	*Lb. Per Gal.*	*Lb. Per Qt.*
3.0	8.33	11.33	1:2.77	25.20	1.034	8.61	2.15
3.1	8.40	11.50	1:2.71	26.95			
3.2	8.46	11.66	1:2.64	27.47			
3.3	8.52	11.82	1:2.58	27.93			
3.4	8.55	11.95	1:2.52	28.41			
3.5	8.60	12.10	1:2.46	28.90	1.033	8.60	2.15
3.6	8.65	12.25	1:2.40	29.40			
3.7	8.69	12.39	1:2.35	29.85			
3.8	8.72	12.52	1:2.30	30.30			
3.9	8.76	12.66	1:2.25	30.77			
4.0	8.79	12.79	1:2.20	31.25	1.032	8.59	2.15
4.1	8.82	12.92	1:2.15	31.74			
4.2	8.86	13.06	1:2.11	32.15			
4.3	8.89	13.19	1:2.07	32.57			
4.4	8.92	13.32	1:2.03	33.00			
4.5	8.95	13.45	1:1.99	33.44	1.032	8.58	2.14
4.6	8.98	13.58	1:1.95	33.90			
4.7	9.01	13.71	1:1.92	34.25			
4.8	9.04	13.84	1:1.88	34.72			
4.9	9.07	13.97	1:1.85	35.09			
5.0	9.10	14.10	1:1.82	35.46	1.031	8.58	2.14
18.0	7.31	25.31	1:0.41	71.11	1.015	8.48	2.12
20.0	7.13	27.13	1:0.36	73.71	1.013	8.43	2.11
22.0	6.95	28.95	1:0.31	75.30	1.011	8.42	2.11
25.0	6.68	31.68	1:0.27	78.91	1.008	8.37	2.10
30.0	6.24	36.24	1:0.21	82.78	1.004	8.36	2.09
35.0	5.79	40.79	1:0.16	85.81	1.000	8.32	2.08
40.0	5.35	45.35	1:0.13	88.20	0.995	8.28	2.07
45.0	4.90	49.90	1:0.09	90.11	0.985	8.22	2.05

TABLE 37. RELATION OF BAUMÉ TO TOTAL SOLIDS IN SWEETENED CONDENSED SKIM MILK

(Assuming a sucrose-in-water ratio of approximately 62%)

Baumé at 120° F.	*Sucrose per cent*	*Serum Solids per cent*	*Total Solids per cent*
37.4	45.63	27	72.63
37.6	45.00	28	73.00
37.8	44.38	29	73.38
38.0	43.75	30	73.75
38.2	43.13	31	74.13
38.4	42.50	32	74.50

Note: While the Baumé reading for total solids is approximately right, too much value should not be given this test for there may be considerable variation due to varying proportions of serum solids and sucrose of different types, and the amount of fat content, etc.

TABLE 38. SODIUM CHLORIDE (SALT) SOLUTION

Degrees Baumé at 60° F.	*Specific Gravity at 39° F.*	*Degrees Salometer at 60° F.*	*Salt per Gallon of Solution lb.*	*Salt per Cubic Foot lb.*	*Salt by Weight %*	*Freezing Point ° F*	*Specific Heat**	*Weight Per Gallon at 39° F. lb.*
1	1.007	4	0.084	0.628	1	31.8	0.992	8.40
2	1.015	8	0.169	1.264	2	29.3	0.984	8.46
3	1.023	12	0.256	1.914	3	27.8	0.976	8.53
4	1.030	16	0.344	3.573	4	26.6	0.968	8.59
5	1.037	20	0.433	3.238	5	25.2	0.960	8.65
6	1.045	24	0.523	3.912	6	23.9	0.946	8.72
7	1.053	28	0.617	4.615	7	22.5	0.932	8.78
8	1.061	32	0.708	5.295	8	21.2	0.919	8.85
9	1.068	36	0.802	5.998	9	19.9	0.905	8.91
10	1.076	40	0.897	6.709	10	18.7	0.892	8.97
12	1.091	48	1.092	8.168	12	16.0	0.874	9.10
15	1.115	60	1.389	10.389	15	12.2	0.855	9.26
20	1.155	80	1.928	14.421	20	6.1	0.829	9.64
24	1.187	96	2.376	17.772	24	1.2	0.795	9.90
25	1.196	100	2.488	18.610	25	+0.5	0.783	9.97
26	1.204	104	2.610	19.522	26	—1.1	0.771	10.04

* Specific Heat: The ratio between the amount of heat required to raise a given weight of substance to a given temperature and the amount of heat required to raise the same amount of water to the same temperature.

TABLE 39. THE FREEZING POINT RELATIONSHIPS OF CALCIUM CHLORIDE BRINE

Per Cent Calcium Chloride Anhydrous	*Per Cent Calcium Chloride Hydrous* $CaCl\text{-}6H_2O$	*Specific Gravity* 18/4 C	*Weight per Gallon*	*Degrees Baumé*	*Degrees Salometer*	*Freezing Point Degrees F.*
1	1.98	1.0070	8.41	1.0	4	31.6
2	3.96	1.0154	8.45	2.2	8	31.3
3	5.94	1.0239	8.54	3.4	12	30.6
4	7.92	1.0319	8.61	4.5	16	29.8
5	9.90	1.0409	8.67	5.7	22	28.9
6	11.88	1.0495	8.75	6.8	26	27.9
7	13.86	1.0582	8.82	8.0	32	26.8
8	15.84	1.0660	8.89	9.0	36	25.5
9	17.82	1.0757	8.96	10.2	40	24.3
10	19.80	1.0847	9.04	11.3	44	22.8
11	21.78	1.0937	9.12	12.4	48	21.6
12	23.76	1.1029	9.19	13.5	52	20.1
13	25.74	1.1121	9.28	14.6	58	18.3
14	27.72	1.1214	9.35	15.7	62	16.7
15	29.70	1.1307	9.42	16.8	68	14.7
16	31.68	1.1402	9.50	17.8	72	12.9
17	33.66	1.1497	9.58	18.9	76	10.8
18	35.64	1.1594	9.67	19.9	80	8.4
19	37.62	1.1692	9.75	21.0	84	5.5
20	39.60	1.1791	9.83	22.0	88	2.7
21	41.58	1.1890	9.91	23.1	92	— 0.6
22	43.56	1.1990	10.00	24.1	96	— 4.4
23	45.54	1.2090	10.08	25.1	100	— 8.3
24	47.52	1.2192	10.16	26.0	104	—13.2
25	49.50	1.2294	10.24	27.1	108	—18.8
26	51.48	1.2398	10.34	28.1	112	—25.1
27	53.46	1.2503	10.42	29.0	116	—32.8
28	55.44	1.2610	10.51	30.0	120	—42.2
29	57.42	1.2718	10.60	31.0	124	—54.4
29.8	58.80	1.2804	10.67	31.8	128	—67.0

VISCOGEN — PREPARATION AND USE

The method of preparing Viscogen as given in Bulletin 54 of the Wisconsin Experiment Station is as follows:

Two and one-half parts by weight of a good quality cane sugar (granulated) are dissolved in five parts of water. One part of quick lime is grad-

ually slacked in three parts of water. This milk of lime should be poured through a wire strainer to remove coarse, undissolved particles, and then this solution is added to the sugar solution.

The mixture should be agitated at frequent intervals for two or three hours, then should be allowed to settle until the clear supernatant fluid (Viscogen) can be siphoned off.

METHOD OF USING VISCOGEN

Both raw and pasteurized cream contain small amounts of lactic acid. In using viscogen great care must be exercised not to add too much because even a slight excess of it will give the cream a bitter and soapy flavor. The safest method of procedure is to determine the amount of viscogen necessary to neutralize the acid in a definite amount of cream and from this determine the amount necessary for the whole batch to be treated. The cream must not be completely neutralized, so one-half to two-thirds of the amount of viscogen necessary for complete neutralization will be sufficient to restore the viscosity to the cream.

Babcock and Russell suggest the following method for determining the amount of viscogen to add: By means of a graduated pipette or burette find the number of cubic centimeters of viscogen needed to neutralize the acid in a pound of cream. Multiply the number of cubic centimeters of viscogen used for one pound of cream by the weight of the cream to be treated. Then find two-thirds of that figure. This will be the number of cubic centimeters of viscogen to add.

EXAMPLE: If it requires 4 cc. of viscogen to neutralize 1 pound of cream, and there are 100 pounds of cream to be treated, then 100×4 cc. $= 400$ cc. of viscogen to neutralize 100 pounds of cream. But the cream should not be completely neutralized; consequently, the amount of viscogen to add to 100 pounds of cream to restore the viscosity will be 2/3 of 400 cc. or 267 cc.

Larsen and White suggest the use of a smaller quantity of cream for titration and make the necessary calculations by the following method. Assuming that it requires 0.6 cc. of viscogen to neutralize 25 cc. of cream, the amount of viscogen needed for say 800 pounds of cream would be 35:0.6::800:x or 13.7 pounds of viscogen. Half this amount is sufficient to restore the viscosity of the cream; therefore, $\frac{0.6 \times 800}{35 \times 2} = 6.8$ lb. of viscogen.

CAUTION. In many states the laws prohibit the addition of any substance to milk or cream, either for the purpose of neutralizing the acidity or for restoring the viscosity, unless the product is so labeled.

TABLE 40. WEIGHTS AND MEASURES

AVOIRDUPOIS WEIGHT

1 grain or minim = smallest unit
27.34375 grains = 1 drachm (dram)
16 drams = 1 ounce
16 ounces = 1 pound = 7000 grains
2000 pounds = 1 ton
2240 pounds = 1 long ton

APOTHECARIES' WEIGHT

20 grains or minims = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound = 5,760 grains

TROY WEIGHT (Used by Jewelers)

24 grains = 1 pennyweight
20 pwts. = 1 ounce
12 ounces = 1 pound

The ounce and pound are the same as in Apothecaries' weight

METRIC (MASS) WEIGHT

10 milligrams = 1 centigram
10 centigrams = 1 decigram
10 decigrams = 1 gram (gm.)
10 grams = 1 decagram
10 decagrams = 1 hectogram
10 hectograms = 1 kilogram (1000 gms.)
10 kilograms = 1 myriagram
10 myriagrams = 1 quintal
10 quintals = 1 metric ton
(1,000,000 gms. or 1 cu. meter = 2204.6 lb.)

LIQUID MEASURE (Capacity or Volume)

60 minims = 1 dram
8 drams = 1 ounce
16 ounces (4 gills) = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon (231 cu. in.)
31½ gallons = 1 barrel
2 barrels = 1 hogshead
1 teaspoonful = 1/6 oz. (1 1/3 dram) (U.S. meas. tsp.)
1 tablespoonful = ½ oz. (3 tsp.)

1 standard measuring cup = 8 oz. or 16 tablespoonfuls

METRIC LIQUID MEASURE*

10 milliliters (ml.) = 1 centiliter
10 centiliters = 1 deciliter
10 deciliters = 1 liter (1,000 ml.)
10 liters = 1 decaliter
10 decaliters = 1 hectoliter
10 hectoliters = 1 kiloliter or stere

* Metric dry measure can be expressed in cubic centimeters (cc).

QUICK REFERENCE TABLE U. S. LIQUID MEASURE

Shows the number of smaller units of measure contained in each larger standard measure.

	Gallon						
Quarts	4	Quart					
Pints	8	2	Pint				
Ounces	128	32	16	Ounce			
Tablespoons	256	64	32	2	Tb'sps		
Teaspoons (U. S.)	768	192	96	6	3	Teasp's	
Drops	61440	15360	7680	480	240	80	

U. S. STANDARD DRY MEASURE

33.6 cu. inches = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon (268.8 cu. in.)
2 gallons (8 qts.) = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

U. S. LINEAR MEASURE (LENGTH)

12 inches = 1 foot
3 feet = 1 yard
5½ yards = 1 rod
320 rods (5,280 ft.) = 1 mile (statute)

METRIC LINEAR MEASURE

10 Angstrom units = 1 millimicron
1,000 millimicrons = 1 micron
1,000 microns = 1 millimeter
10 millimeters = 1 centimeter (cm.)
10 centimeters = 1 decimeter
10 decimeters = 1 meter
10 meters = 1 decameter
10 decameters = 1 hectometer
10 hectometers = 1 kilometer (0.62137 mile)

U. S. STANDARD SQUARE MEASURE (AREA)

144 sq. inches = 1 sq. foot
9 sq. ft. = 1 sq. yard
30¼ sq. yds. = 1 sq. rod
160 sq. rds. = 1 acre
43,560 sq. ft. = 1 acre
640 acres = 1 sq. mile

Conversion Equivalents

WEIGHT

1 grain (Avoir.) = 0.0648 grams
1 scruple (Apoth.) = 1.296 gms.
1 ounce (Avoir.) = 28.3491 gms.
1 ounce (Troy) = 31.103 gms.
1 lb. (Avoir) = 0.4536 kilograms
1 lb. (Troy) = 0.3729 kilograms
1 gram = 15.432 grains
1 gram = 0.772 scruples (Apoth.)
1 gram = 0.035 ounce (Avoir.)
1 gram = 0.032 ounce (Troy)
1 kilogram = 2.20462 lb. (Avoir.)
1 kilogram = 2.679 lb. (Troy)

CAPACITY

1 cu. in. = 16.4 cc.
1 U. S. minim = 0.0616 milliliter
1 U.S. dram = 3.697 ml. or cc.*
1 U. S. teaspoon = 4.9 ml. or cc. (1 1/3 drams)
1 U.S. fluid oz. = 29.574 ml. or cc.
1 U.S. liquid qt. = 0.946 liters
1 U.S. gallon = 3.785 liters
1 U.S. bushel = 0.3524 hectoliters
1 ml.* or 1 cc. = 0.061 cu. in.
1 ml. or 1 cc. = 16.228 minims
1 ml. or 1 cc. = 0.2705 drams
1 ml. or 1 cc. = 0.034 U.S. fl. oz.
1 liter = 1.05668 U.S. liquid qt.
1 liter = 0.264 U.S. gallon
1 hectoliter = 2.838 U.S. bu.

* For practical purposes 1 milliliter equals 1 cubic centimeter (cc).

LENGTH

1 inch = 2.5400 centimeters (cm.)
1 foot = 0.3048 meters or 30.480 cm.
1 yard = 0.9144 meter or 91.4401 cm.
1 mile = 1.609 kilometers
1 cm. = 0.3937 inch
1 cm. = 0.0328 ft.
1 meter = 1.09361 yds.
1 kilometer = 0.621 mile

TEMPERATURE

To Convert Degrees Fahrenheit to Degrees Centigrade

Degrees C. = (degrees F. — 32) x 5/9

To Convert Degrees Centigrade to Degrees Fahrenheit

Degrees F. = (degrees C. x 9/5) + 32

SALES EXPECTANCY TABLE

TABLE 41. THIS TABLE WILL HELP TO DETERMINE THE EQUIPMENT NECESSARY TO SERVE PROPERLY ANY DEALER WHO WILL TELL YOU HIS TOTAL MONTHLY SALES AT ANY TIME, BASED UPON NATIONAL AVERAGES.

	Per Cent of Year	*Gallons Used Per Month*												
January	3.42	7	10	14	17	20	24	27	30	34	40	51	68	102
February	3.80	8	12	16	20	24	27	31	36	38	48	57	76	114
March	5.33	11	16	22	27	32	37	43	48	53	64	80	107	160
April	7.17	14	21	28	35	42	50	57	63	72	84	108	143	215
May	10.90	22	33	44	55	66	76	87	99	109	132	164	218	327
June	14.50	29	44	58	73	88	102	116	132	145	176	217	290	435
July	16.58	33	50	66	83	100	116	133	150	166	200	249	332	498
August	14.27	29	43	58	72	86	100	114	129	143	172	214	285	428
September	10.04	20	30	40	50	60	70	80	90	100	120	151	201	301
October	6.17	12	18	24	30	36	43	49	54	62	72	93	123	185
November	4.19	8	12	16	20	24	29	34	36	42	48	62	84	126
December	3.63	7	11	14	18	22	26	29	33	36	44	54	73	109
TOTAL	100.00%	200	300	400	500	600	700	800	900	1000	1200	1500	2000	3000

TABLE 42. LEGAL MINIMUM STANDARDS FOR ICE CREAM BY STATES CORRECTED TO JANUARY 1, 1950

	Plain Ice Cream				Fruit. Nut Ice Cream				Frozen Custard				
	Milk Fat %	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. Per Gal.*	*Milk Fat %*	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. per Gal.*	*Egg Yolks or Equiv.*	*Milk Fat %*	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. per Gal.*
Federal	....	.....	....	.....	....	....	....	.....	....	....	.....	....	.....
Alabama	10	18	1.6	.....	8	18	1.6	.....	....	10	....	....	.....
Alaska	10	18	1.6	.....	8	14	1.6	.....	30 per 46 lb.	8	33T	....	.....
Arizona	10	.....	30%	.....	8	....	30%	.....	....	....	.....	....	.....
Arkansas	10	18	1.6	.....	8	14	1.6	.....	30 per 90 lb.	10	14	1.6	.....
California	10	.....	1.6	.....	8	....	1.6	.....	60 per 90 lb.	10	.....	....	.....
Colorado	12	.....	....	.....	10	....	....	.....	....	....	.....	....	.....
Connecticut	10	36T	1.6	.....	8	34T	1.6	.....	....	....	.....	....	.....
Delaware	12	.....	....	.....	10	....	....	.....	....	12	.....	....	.....
Dist. Columbia	8	.....	....	.....	8	....	....	.....	....	....	.....	....	.....
Florida	10	18	1.6	.....	8	14	1.6	.....	....	10	18	1.6	.....
Georgia	10	.....	....	4.50	8	....	....	4.50	....	....	.....	....	.....
Hawaii	12	18	1.6	4.50	10[1]	15[1]	1.6[1]	4.50[1]	....[2]	12	18	....	.....
Idaho	12	18	1.6	4.25	10	14	1.6	4.25	....	....	.....	....	.....
Illinois	12	.....	....	.....[3]	10	....	....	.....[3]	....	....	.....	....	.....
Indiana	10	18	1.6	4.25	8	14	1.6	4.25	....	....	.....	....	.....
Iowa	12	20	1.6	4.50	10	16	....	4.50	3 lb. per 90 lb.	10	.....	....	.....
Kansas	10	20	33%	.....	10	20	33%	.....	....	....	.....	....	.....
Kentucky	10	18	....	.....	10[4]	18[4]	....	.....	....	10[4]	18[4]	.....	.....
Louisiana	10	20	1.6	4.50	8	6	1.4	4.50	....	8	18	....	.....
Maine	12	.....	....	.....	10	....	....	.....	....	....	.....	....	.....
Maryland	12	20	....	4.50	10	15	....	4.50	60 per 90 lb.	12	20	....	.....
Massachusetts	10	18.5	1.6	.....	8	16.5	1.6	.....	60 per 90 lb.	10	18.5	1.6	.....
Michigan	12	.....[5]	1.6	.....	10	....[5]	1.6	.....	....	12	.....[5]	1.6	.....
Minnesota	12	20	1.6	4.50	10	16	1.6	4.50	5 per gal.	12	20	1.6	4.50
Mississippi	10	35T	1.6	4.50	8	35T	1.6	4.50	....	8	16	1.6	4.50

T Total solids, not total milk solids
[1] Also for chocolate ice cream
[2] Not less than 1.4% egg yolk solids
[3] Not more than 100% overrun
[4] Before the addition of fruit, nuts, or eggs
[5] Not less than 0.9 lb. milk solids per gallon

TABLE 42.—CONTINUED

	Plain Ice Cream				Fruit, Nut Ice Cream				Frozen Custard				
	Milk Fat %	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. Per Gal.*	*Milk Fat %*	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. per Gal.*	*Egg Yolks or Equiv.*	*Milk Fat %*	*Total Milk Solids %*	*Food Solids lb. per Gal.*	*Wt. per Gal.*
Missouri	8	.....	....	.....	8	....	....	.....	....	....	.....	....	.....
Montana	10	.....	33%	.....	9	....	33%	.....	....	10	.....	33%	.....
Nebraska	12	20	....	4.50	10	18	....	4.50	....	12	20	....	.....
Nevada	14	.....	....	4.50	12	....	....	4.50	2% Egg solids		.....	....	.....
New Hampshire	14	.....	....	4.50	12	....	....	4.50	...	14	.....	....	4.50
New Jersey	10	.....	....	.....	8	....	....	.....	60 per 90 lb.	10	.....	....	.....
New Mexico	12	20	....	.....	10	....	....	.....	....	....	.....	....	.....
New York	10	18	1.6	.....	8[1]	14[1]	1.6	.....	...[2]	10	18	1.6	.....
North Carolina	10	35T	1.6	4.50	8	35T	1.6	4.50	60 per 90 lb.	8	16	1.6	.....
North Dakota	12	.....	....	4.50	10	....	....	4.50	....	....	.....	....	.....
Ohio	10	18	....	4.25	8[1]	14[1]	....	4.25	60 per 90 lb.	10	18	....	4.25
Oklahoma	10	21	....	4.50	10	21	....	4.50	....	....	.....	....	.....
Oregon	12	20	1.6	4.50	10	18	1.6	4.50	....	....	.....	....	.....
Pennsylvania	10	.....	1.8	4.75	8	....	1.8	4.75	....	....	.....	....	.....
Rhode Island	8	.....	....	.....	8	....	....	.....	....	....	.....	....	.....
South Carolina	10	18	1.6	4.25	10[4]	18[4]	1.6	4.25	60 per 90 lb.	10	18	1.6	4.25
S. Dakota	12	.....[5]	1.6	4.50	10[1]	[1]....[5]	1.6	4.50	60 per 90 lb.	12	.....[5]	1.6	4.50
Tennessee	10	18	1.6	.....	8[1]	14[1]	1.6	.....	30 per 90 lb.	8	14	1.6	.....
Texas	8	.....	....	.....	6	....	....	.....	....	....	.....	....	.....
Utah	12	28T	1.6	.....	9	26T	1.6	.....	....	....	.....	....	.....
Vermont	14	.....	1.6	4.50	12	....	1.6	4.50	....	....	.....	....	.....
Virginia	10	35T	....	4.50	8[1]	35T[1]	.....	4.50	30 per 46 lb.	8	33T	....	.....
Washington	10	20	....	.....	10	20	....	.....	....	....	.....	....	.....
West Virginia	8	18	....	.....	8[4]	18[4]	....	.....	....	....	.....	....	.....
Wisconsin	13	.....	....	.....[6]	11	....	....	.....[6]	5 per Gal.	13	.....	....	.....
Wyoming	10	18[7]	1.6	4.25	10	18[7]	1.6	4.25	5 per Gal.	10	18[7]	1.6	4.25

[6] Melted volume shall not be less than half the volume when manufactured or sold
[7] Not less than 37% total solids

FROZEN DESSERTS PLANT INSPECTION FORM

The Federal Security Agency of the U. S. Public Health Service has recommended a "Frozen Desserts Ordinance and Code" which embodies the best information at present available on frozen-desserts-control legislation. It includes the following items of sanitation to be considered when inspecting a frozen desserts factory.

FROZEN DESSERTS PLANT INSPECTION FORM

.....

(City, county, or district)

Name..... Location.....

Sir: An inspection of your plant has this day been made, and you are notified of the defects marked below with a cross (x). Violation of the same item on two successive inspections calls for immediate degrading or suspension of permit.

(1) *Floors.*—Smooth finish, no pools ( ), wall joints and floor surface impervious ( ), trapped drains (cold storage rooms and counter freezer plants excepted), no sewage back-flow ( ), clean and free of litter ( ).....( )

(2) *Walls and ceilings.*—Smooth, washable, light-colored finish (hardening and storage rooms excepted), good repair ( ), clean ( ).....( )

(3) *Doors and windows.*—In fly season outer openings with effective screens and self-closing doors, or fly-repellent fans or flaps.....( )

(4a) *Lighting.*—10 foot-candles 30 in. above floor (For natural light in new plants see Code) .....( )

(4b) *Ventilation.*—No undue condensation and odors (cold storage rooms excepted) .....( )

(5) *Miscellaneous protection from contamination.*—Tanks and vats covered, ports protected ( ), no woven-wire strainers, no straining pasteurized mix except through perforated metal ( ), no drip from mezzanine or overhead pipes ( ), flies under control ( ), processes partitioned (or approved enclosures in counter freezer plants) ( ), rooms of sufficient size ( ), ingredients not unloaded directly into processing rooms ( ), pasteurized product not in contact with equipment used for raw or lower grade products unless sterilized ( ), no plant operations in living quarters ( ) .....( )

(6) *Toilet facilities.*—Comply with plumbing code ( ), good repair ( ), clean ( ), outside ventilation ( ), no direct opening ( ), self-closing doors ( ), free of flies ( ), washing sign ( ), privies, if used, comply State standards ( ).....( )

(7) *Water supply.*—Sufficient outlets ( ), adequate ( ), safe, complies State standards ( ) .....( )

(8) *Hand-washing facilities.*—Adequate, convenient ( ), hot and cold water, soap, sanitary towels ( ), hands washed after toilet ( ).....( )

(9) *Sanitary piping.*—Easily cleanable size, shape, and length ( ), smooth uncorroded surfaces ( ), sanitary fittings, interior surfaces accessible for inspection ( ).( )

(10) *Construction and repair of containers and equipment.*—Easily cleanable, smooth, non-corrodible surfaces ( ), no open seams, good repair ( ), self-draining ( ), pressure-tight seats on submerged thermometers ( ) ..... ( )

(11) *Disposal of wastes.*—In public sewer or as approved by State board of Health ( ), no connection or back-siphonage into water supplies ( ), trash and garbage kept in covered containers ( ) ..... ( )

(12a) *Cleaning of containers and equipment.*—Multi-use containers thoroughly cleaned after each usage ( ), equipment each day ( ) ..... ( )

(12b) *Bactericidal treatment of containers and equipment.*—Containers treated after each cleaning in steam cabinet 170° F. for 15 min., or 200° F. for 5 min., or hot-air cabinet 180° F. for 20 min., or steam jet 1 min., or immersed in standard chlorine or 170° F. water for 2 min., or automatic washers (residual count not over 1 per cc of capacity, test 11), assembled equipment treated daily immediately before run, with flow of 200° F. steam or 170° F. water at outlets for 5 min. or standard chlorine flow for 2 min. (test 12); supplementary treatment for surfaces not thus reached ( ) ..... ( )

(13) *Storage of containers.*—In clean crates or racks above floor, protected from flies, splash, dust, inverted when practicable ..... ( )

(14) *Handling of containers and equipment.*—No handling of surfaces to which ingredients or products are exposed ..... ( )

(15) *Storage and handling of single-service containers and utensils.*—Purchased in sanitary tubes or cartons ( ), kept therein in cabinet or other clean dry place ( ), sanitary handling ( ) ..... ( )

(16a) *Specifications for pasteurization thermometers.*—All Code specifications met by all new indicating and recording thermometers, by all replacements, and by recording thermometers under repair which require renewal of tube system ( ); existing thermometers meet at least accuracy and lag specifications (tests 1, 2, 3) ( ) ..... ( )

(16b) *Maintenance of pasteurization time and temperature.*—Entire mix, excluding fruits, etc., pasteurized, no raw products bypass around pasteurizers ( ). Requirements for manual-discharge heated holders (for others see Code):

Temperature control.—Adequate agitation throughout holding period, agitator sufficiently submerged ( ); indicating and recording thermometers on each vat throughout pasteurization ( ); recorder reads no higher than indicator (test 4) ( ); thermometer bulbs submerged ( ) ..... ( )

Time control.—Charts show 155° F. for 30 minutes, plus emptying time if cooling begun after outlet valve opened (also plus filling time when required) (test 6) ( ); no milk added after holding begun ( ) ..... ( )

Charts.—Used only 1 day, preserved 3 months ( ); must show date, location, daily check against indicating thermometer, amount and product represented, unusual occurrences, and operator's signature ( ) ..... ( )

(16c) *Inlet and outlet valves and connections.*—Any inlet and outlet valves used on single-vat installations must be leak-protector type, otherwise piping disconnected ( ), all multiple-vat installations have leak-protector inlets, also leak-protector out-

lets except where Code permits disconnecting outlet piping instead ( ), 30-minute tubular holders have leak-protector outlet or outlet piping disconnected until 30 minutes after filling begun ( ); leak-protector valves of approved design, effective in all closed positions, and installed in proper position (test 8) ( ); inlets and outlets below mix level have close-coupled valves ( ); plug-type valves have approved stops ( ); top inlets have air relief if submerged ( ). Valves kept fully closed except inlet while filling and outlet while emptying ( ); outlet valves sterilized automatically before opening if not leak protected or if mix accumulates in channel (test 9) ( ) ..... ( )

(16d) *Air heating.*—Air in vats and pockets heated to at least 5° F. above mix temperature during heating and kept at 160° F. or higher during holding, with approved device ( ), approved trap on steam line ( ), approved air thermometer (test 7), bulb at least 1 inch above mix ( ) ..... ( )

(16e) *Vat and pocket covers and cover ports.*—No drainage from top of cover into vat, open or closed ( ), ports surrounded by raised edges ( ), pipes, thermometers, etc., through cover have aprons unless joint watertight ( ); covers kept closed ( ) ..... ( )

(16f) *Preheating holders.*—Holders not used as heaters are preheated to pasteurization temperature just before run, also when empty after shutdown exceeding holding period, unless outlet has flow-diversion valve ..... ( )

(17a) *Cooling.*—All fluid milk products cooled to 50° F. on receipt unless to be pasteurized within 2 hours ( ), pasteurizing mix cooled to 50° F. and held thereat until frozen ( ); header gap on surface coolers not less than ¼ inch or thickness of header at gap ( ), condensation and leakage from cooler supports and headers, unless completely enclosed in covers, directed away from tubes and milk trough ( ), recirculated water and refrigerant of required sanitary quality ( ), cooler covered or in separate room ( ), cooler shields tight fitting ( ), in regenerators, pasteurized-mix (or heat-transfer-medium) side automatically under greater pressure than raw mix at all times (see Code) ( ) ..... ( )

(17b) *Handling of mix.*—If not frozen where pasteurized, mix transported in sealed containers ( ), protected against contamination, no dipping, kept covered ( ) ( )

(18) *Packaging.*—If not approved automatic equipment: no contact surfaces handled, packages adequately covered immediately after filling ( ); hands washed and disinfected before beginning moulding, wrapping, or packaging and after each interruption ( ), brick and fancy moulds handled in sanitary manner by trained persons ( ) ..... ( )

(19) *Overflow or spillage.*—Discarded ..... ( )

(20) *Returns.*—No opened containers of mix or frozen desserts returned except for inspection ..... ( )

(21) *Personnel, health.*—Required examinations and tests ( ), rejected persons not employed ( ), no person with infected wound or lesion ( ) ..... ( )

(22) *Personnel, cleanliness.*—Clean outer garment, washable for inside employees ( ), hands clean ( ) ..... ( )

(23) *Miscellaneous.—Vehicles*: Clean ( ), covered ( ), no contaminating substances transported ( ), distributor's name shown ( ). *Surroundings:* Kept neat and clean ( ) ..... ( )

(24) *Bacterial plate count of pasteurized mix or frozen desserts.*—Log average not over 50,000 ( ), 100,000 for grade B ( ) ..... ( )

(25) *Ingredients.*—Clean, fresh wholesome flavor, odor, and appearance ( ), stored above floor, kept covered, properly handled and refrigerated ( ); milk products meet bacterial standards ( ), also production standards, where locally required ( ); ingredients added after mix pasteurized are of approved quality ( ) ..... ( )

PROVISIONS OF THE ORDINANCE

A brief outline of the provisions of the ordinance may be of value in this discussion.

Section 1 deals exclusively with definitions. Frozen desserts include partially frozen combinations of the usual ingredients, so as to enable the health officer to control also similar products which are not completely frozen. Composition standards for the various types of frozen desserts have been omitted, but when such standards are issued by the Food and Drug Administration they will be included as suggested standards in later editions of the ordinance. All mix must be pasteurized by heating every particle to 155° F. and holding for at least 30 minutes in approved equipment, or by any other equally efficient process approved by the state health authority. A number of other terms are defined.

Section 2 prohibits the sale of adulterated or misbranded mix or frozen desserts. Section 3 deals with the issuing, suspension, and revocation of permits, and is broad enough to include retailers who do not manufacture or freeze if the health officer wishes so to interpret it. Section 4 prescribes the labeling of containers and prohibits the use of unapproved grade placards.

Section 5 requires the inspection of all plants at least once every 6 months. A plant found violating any item of sanitation must be notified in writing and must be given a reasonable time to correct the defect. If the same violation is again found on the next inspection the plant is subject to degrading or suspension of permit.

Section 6 provides for the examination of at least 4 samples of the finished product from each plant every 6 months. The decision as to whether at least 4 samples of each flavor of each product shall be taken or random sampling should be relied upon to represent all products of the plant, is left to the individual health officer's judgment and will depend on the laboratory facilities available. Ingredients may be sampled as often as the health officer may deem necessary in order to determine compliance with the bacterial requirements. If the logarithmic average of the last 4 bacterial

counts exceeds the specified standard, the plant must be notified and an additional sample taken before punitive action is in order.

Section 7, the longest and most important of the sections, lists the sanitation standards for grade A frozen desserts plants, which are identical with the minimum requirements where the non-grading form is adopted. These cover construction and cleanliness of floors, walls and ceilings, doors and windows, lighting and ventilation, protection from contamination, toilet, water supply, handwashing facilities, sanitary piping, disposal of wastes, the construction, cleaning, bactericidal treatment, storage, and handling of containers and equipment, pasteurization of mix, cooling, handling, packaging spillage, returns, health and cleanliness of personnel, vehicles, plant surroundings, bacterial count of frozen desserts, and standards for ingredients. These items of sanitation are conveniently summarized in the frozen desserts plant inspection form prepared for use with this ordinance. Except for the few items specifically applying to frozen desserts, the sanitation requirements are similar to those for pasteurization plants in the recommended milk ordinance, and need not be discussed here.

The bacterial standard for pasteurized mix and frozen desserts is a logarithmic average plate count not exceeding 50,000 per gram. With pasteurization set at 155° F. for 30 minutes, this standard is not considered too stringent for the top grade.

SANITARY CONTROL OF INGREDIENTS

For the present, only platform control is made mandatory in the ordinance. Item 25p, which deals with ingredients, contains a general requirement as to cleanliness, quality, and handling of ingredients, and establishes bacterial standards for ingredients derived from milk. Those used in the raw state are limited to a logarithmic average plate count not exceeding 200,000; those used in the pasteurized, condensed, evaporated, or dried state are limited to an average of 50,000. These limits are doubled in the case of cream. In the Code, tentative microbiological standards are recommended for ingredients not derived from milk, including a plate count of under 200,000 for egg products, and for other flavoring or coloring materials a plate count not exceeding 10,000 and mold and yeast counts not exceeding 100. These standards are particularly recommended for all ingredients added after the mix has been pasteurized.

IMPORTANT DAIRY PUBLICATIONS

Ice Cream Trade Journal
304 E. 45th St., New York 17, N. Y.

Ice Cream Review
1445 N. 5th St. at W. Cherry, Milwaukee 12, Wisconsin

Ice Cream Field
19 W. 44th St., New York 18, N. Y.

Canadian Dairy and Ice Cream Journal,
122 Richmond St., West, Toronto, Ontario, Canada

Journal of Dairy Science
Official Organ of the American Dairy Science Association
Ohio State University, Columbus 10, Ohio

DAIRY ASSOCIATIONS WHICH PROMOTE THE ICE CREAM INDUSTRY

American Dairy Science Association
Columbus 10, Ohio

International Association of Ice Cream Manufacturers
Robert C. Hibben, Executive Secretary
1105 Barr Building, Washington 6, D. C.

The National Association of Retail Ice Cream Manufacturers, Inc.
E. M. Warder, Executive Secretary
Executive Headquarters, Commerce Building, Toledo 4, Ohio.

National Ice Cream Mix Association, Inc.
234 Bowen Building, Washington 5, D. C.

National Dairy Council,
111 North Canal Street, Chicago 6, Illinois

Dairy Industries Supply Association, Inc.
Roberts Everett, Executive Vice President
1108 Sixteenth Street N. W., Washington 6, D. C.

American Dairy Association
O. M. Richards, General Manager
20 N. Wacker Drive Building, Chicago 6, Illinois

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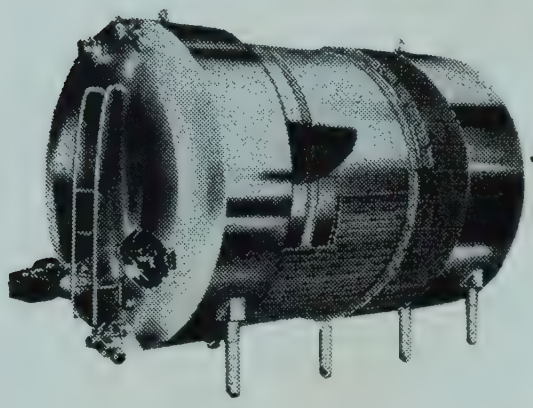
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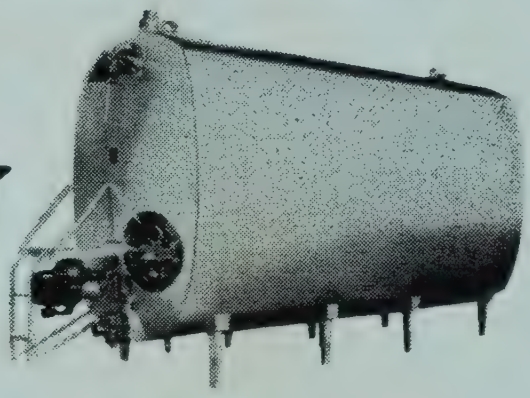
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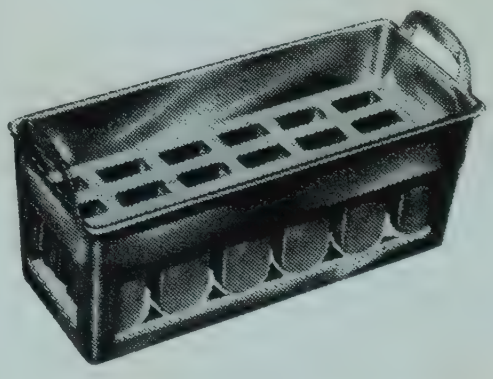
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VEL-MARSH Marshmallow Powder Base lets you make high-quality marshmallow quickly and economically in your continuous freezer, simultaneously variegating it with your ice cream mix.

AMERICAN FOOD'S STABILIZERS

S-233, the all-purpose stabilizer-emulsifier, maintains uniformity of body and texture, protects against heat shock, controls over-run, provides desired viscosity and luster. In addition, it emulsifies any mix, regardless of butterfat content, producing a more homogenous product, with better whipping and faster freezing. Soluble, hot or cold. No aging needed.

STA-VEL Stabilizer prevents crystallization while it produces a more desirable body, texture and melt-down in all types of frozen sweets. Whips quickly to desired over-run. Mix needs no aging.

Sta-Vel saves 50 percent of your fruit! Saves the juice by virtually eliminating drainage of this most flavorful, colorful part of the fruit — the half which is usually discarded or diverted. Used before the fruit is quick-frozen, it keeps juice in after defrosting. Used after defrosting, it draws drained juices back. In either case, prevents ice crystallization.

AMERICAN FOOD'S EMULSIFIERS

Extremely efficient in breaking fat into microscopic globules, resulting in a faster-whipping ice cream of superior eating quality.

MARCOID—a liquid, is added before or after pasteurization. Instantly soluble, hot or cold.

WILCOID—a powder, makes an excellent dry type of ice cream. Added to pasteurizer with the stabilizer. Instantly soluble at pasteurizing temperature.

CONCENTRATE "A"—A plastic emulsifier. Only 7 oz. of this high-potency concentrate are needed to properly emulsify 100 gal of 12% mix. Ratio of emulsifier to stabilizer can be delicately adjusted.

AMERICAN FOOD LABORATORIES, INC.

860 Atlantic Ave., Brooklyn 17, N. Y.

Write for catalog and prices of complete line, and for our popular Technical and Research Department Reference sheets

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V-31-E A wholly edible CARBOHYDRATE; no extenders; readily dispersed in hot or cold mixes. About 8 oz. per 100 gals. of mix (0.055%) an effective amount.

G-31-E A wholly edible PROTEIN; basically a high test edible gelatin. About 2 lbs. per 100 gals. of mix (0.22%) an effective amount.

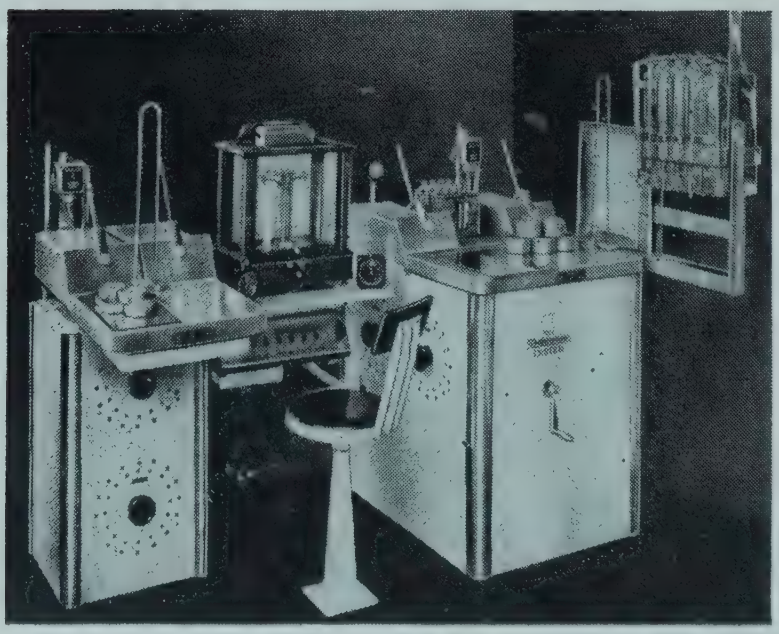
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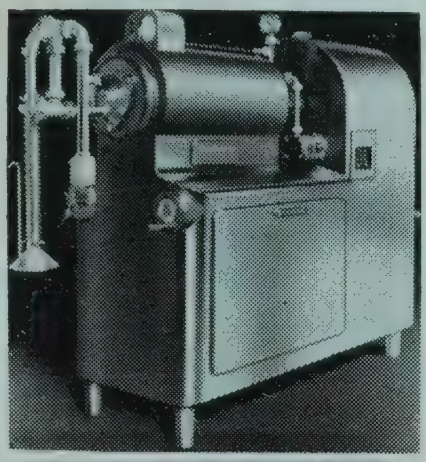
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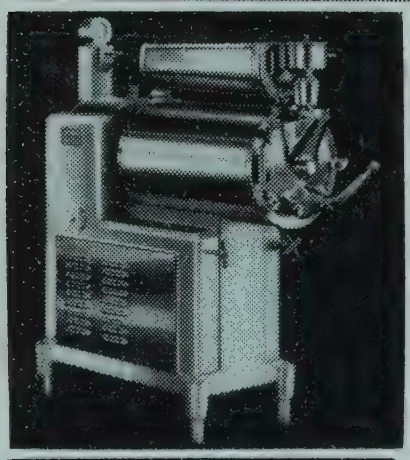
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Modern ICE CREAM EQUIPMENT



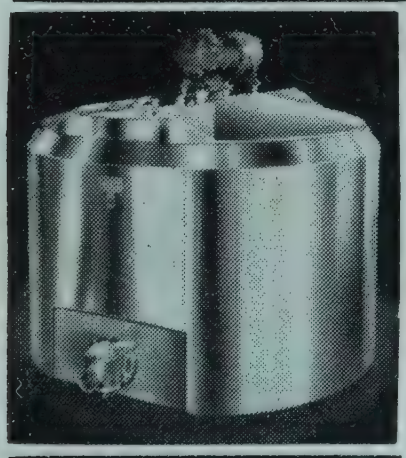
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THE ROUND PROCESSOR

The Round Processor was specifically designed to handle heavy bodied products, especially ice cream mix. The new stainless steel model is available in five capacities—300, 500, 600, 800, and 1,000 gallons. Send for special bulletin which gives complete details of operation and construction.



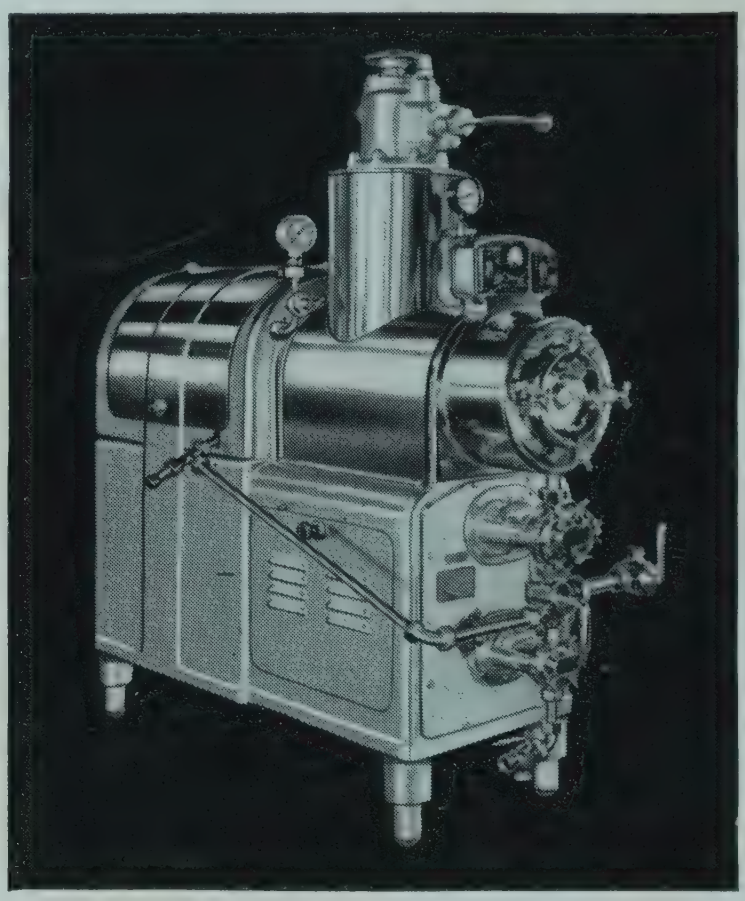
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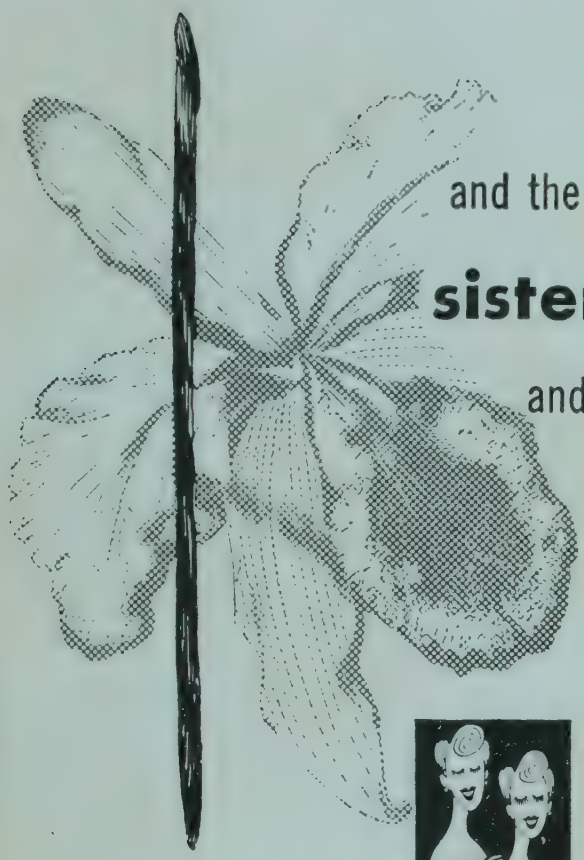
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the orchid

and the vanilla bean are

sisters under the skin

and one is as glamorous

as the other

Just as the orchid's delicate beauty attracts the eye, so does the subtle flavor of vanilla tempt the taste buds. That's why when people ask for ice cream, they say most often —"Make mine vanilla", knowing that this orchid of flavors enhances—but does not overwhelm—the food it touches.

In this respect, Michael's Mixevan reaches perfection among vanilla flavorings. The success of this powdered vanilla, which is made from the vanilla bean and vanillin derived from tropical spices, starts with the bean itself.

This most glamorous bean in the world, requires careful hand-pollination . . . the growing of support trees . . . many long months for maturity . . . curing under the sun and in the shade . . . and rare father-to-son skills of the vanilla farmer.

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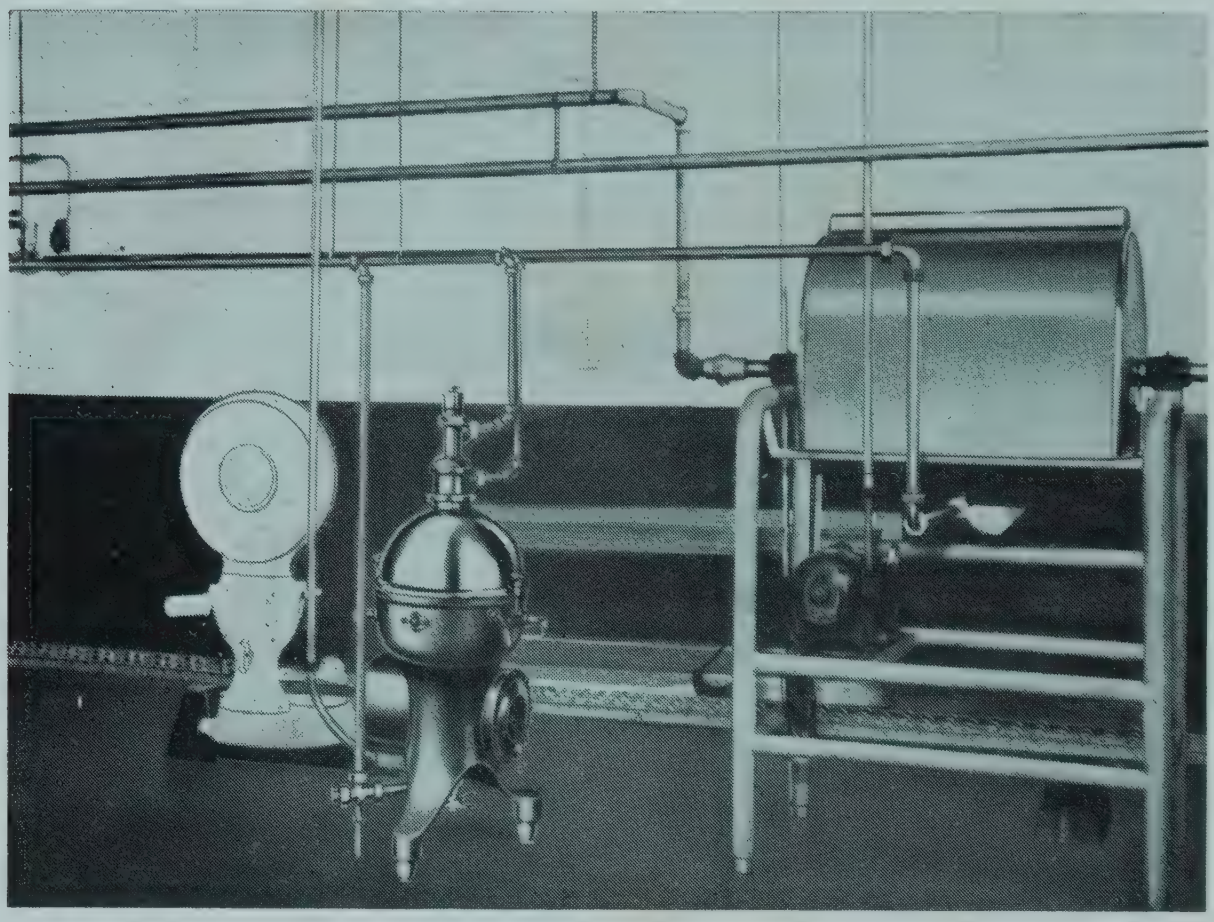
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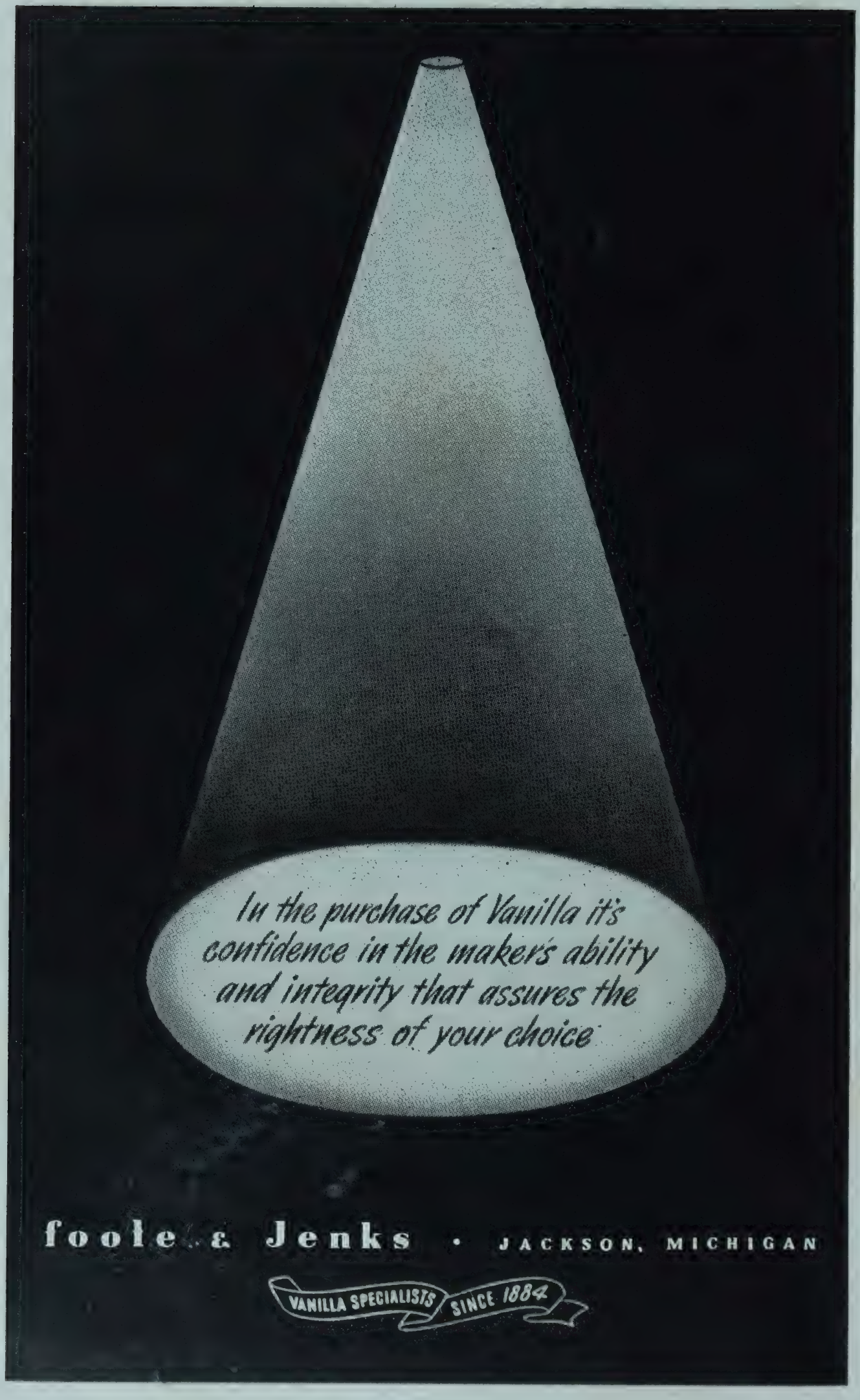
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- Makes smooth, creamy, full-bodied ice cream.

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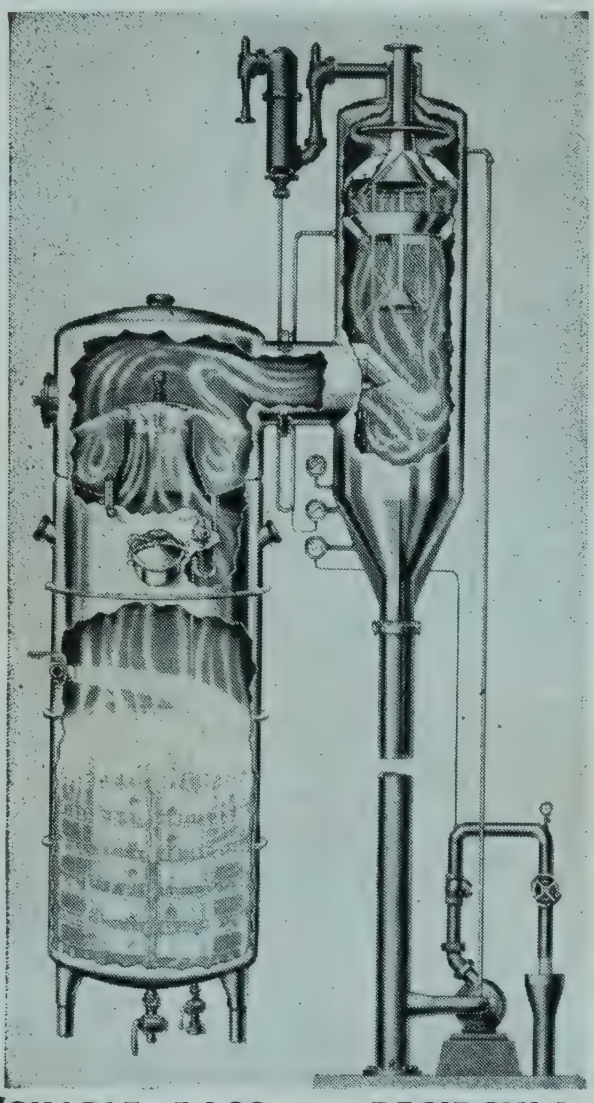
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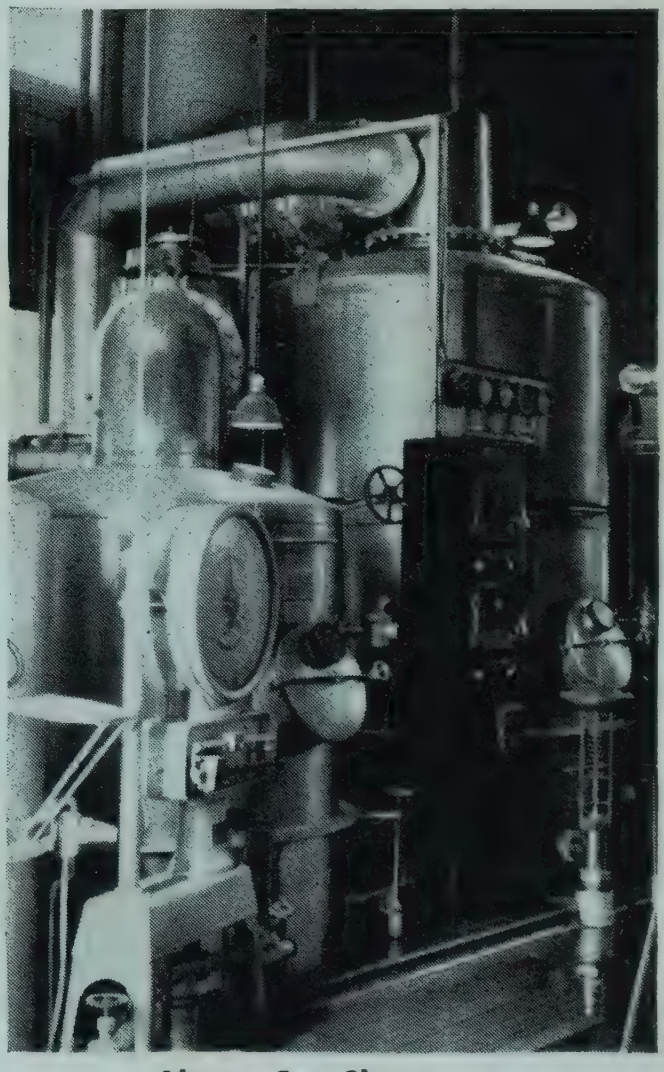


with entrainment separation chamber and counter-current condenser.

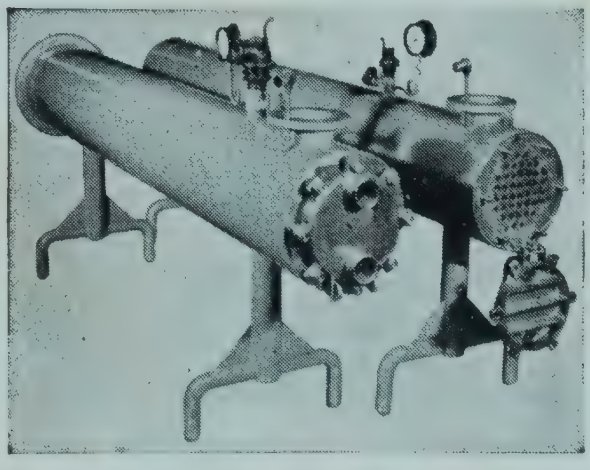
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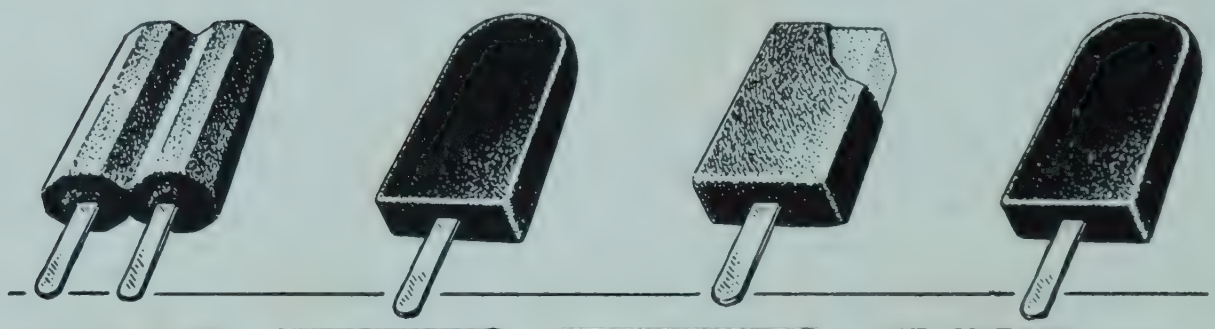
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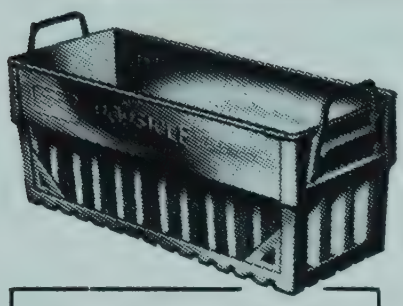
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"TWIN POPSICLE" Mold produces 24 four ounce confections; rust proof, sanitary, long-life sturdy construction.

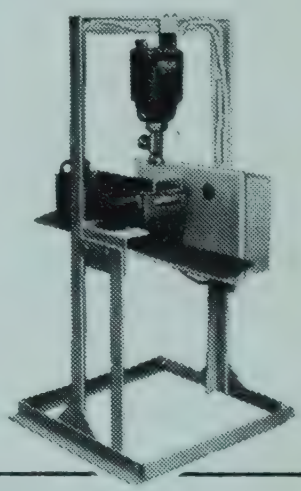
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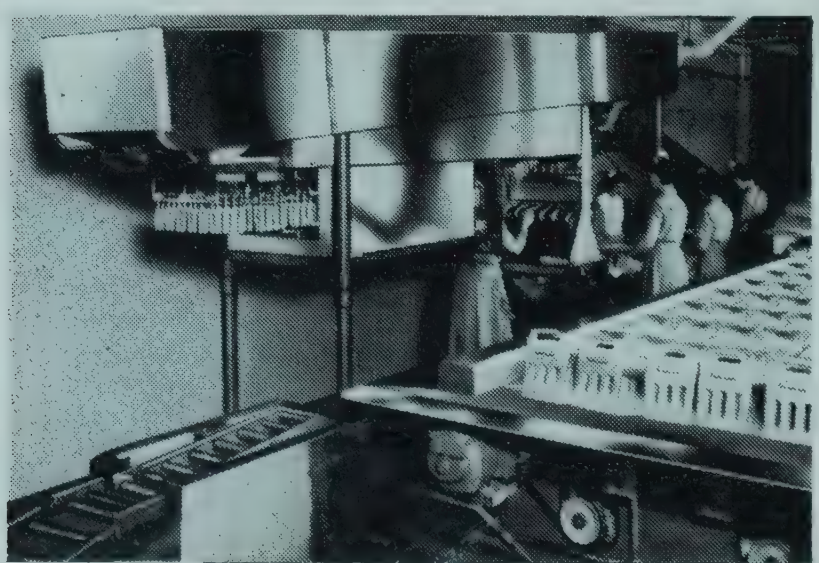
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"POPSICLE" Mold Filler. Operates with photo electric control and electronic timer. Entirely automatic. Stainless steel sanitary type solenoid valve, with sanitary fittings.



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Defroster illustrated here automatically starts the emptied mold to filling station.

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COMPLETE LINE OF SODA FOUNTAIN SUPPLIES

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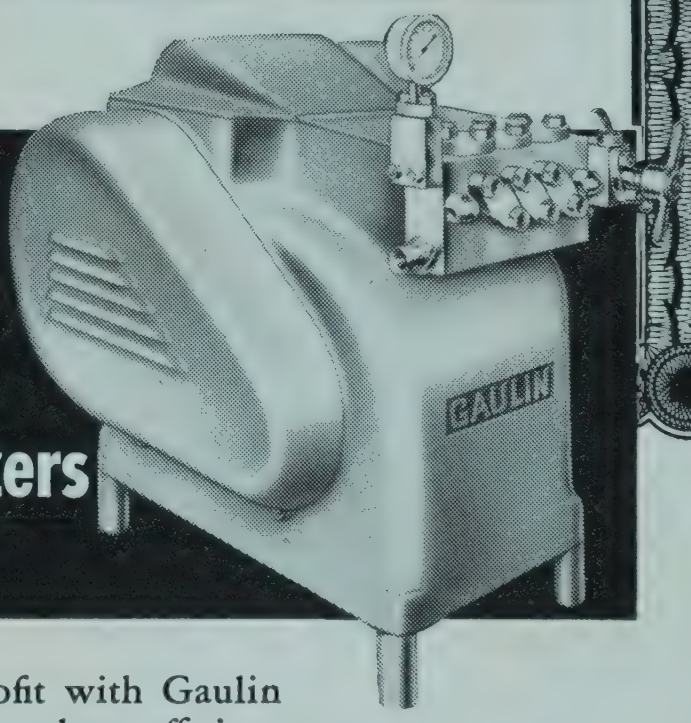
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GAULIN
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Ice cream makers profit with Gaulin Homogenizers. These ultra efficient homogenizers help you make the best quality ice cream . . . quality that attracts new customers . . . builds better customer relations with your old ones.

Gaulin Homogenizers, the homogenizers with the original two-stage valve, give you positive ice cream control. They enable you to maintain the same uniform "Good-Taste" day in, day out.

Gaulin Homogenizers are built to give dependable performance years on end. Their modern design and clean appearance meet the layout requirements of every plant. Extremely sanitary, they are easy to keep clean. That's why you'll find more Gaulin Homogenizers used in plants than all others combined.

See your jobber or write for Bulletin which describes the Gaulin two-stage Homogenizer in detail.

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MANUFACTURING CO., INC.
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Made of selected Northern hardwood in the true shape and with the full bowl capacity of table silver, OWD Ritespoon is the most widely useful and popular single-service spoon available. Made in four sizes and with OWD Ritefork these beautiful, smooth, eating utensils are meeting every service need in countless thousands of public refreshment places with assured sanitation, economy and speed in service. The 10 cent tray for home use is sold in many of the places where OWD Ritespoons are served. We will gladly send samples and data.



OWD 3" Flat Wrapped Spoons

Sealed in its envelope of sanitary paper the OWD 3" flat wood spoon provides absolute sanitation in the eating of ice cream carried out of the store, especially cups and other prepared retail portions. These wrapped spoons are available singly or in fan-folded strips of any desired number. The envelope printed with brand name, or a message, becomes a valuable advertising medium. Write for samples and data.

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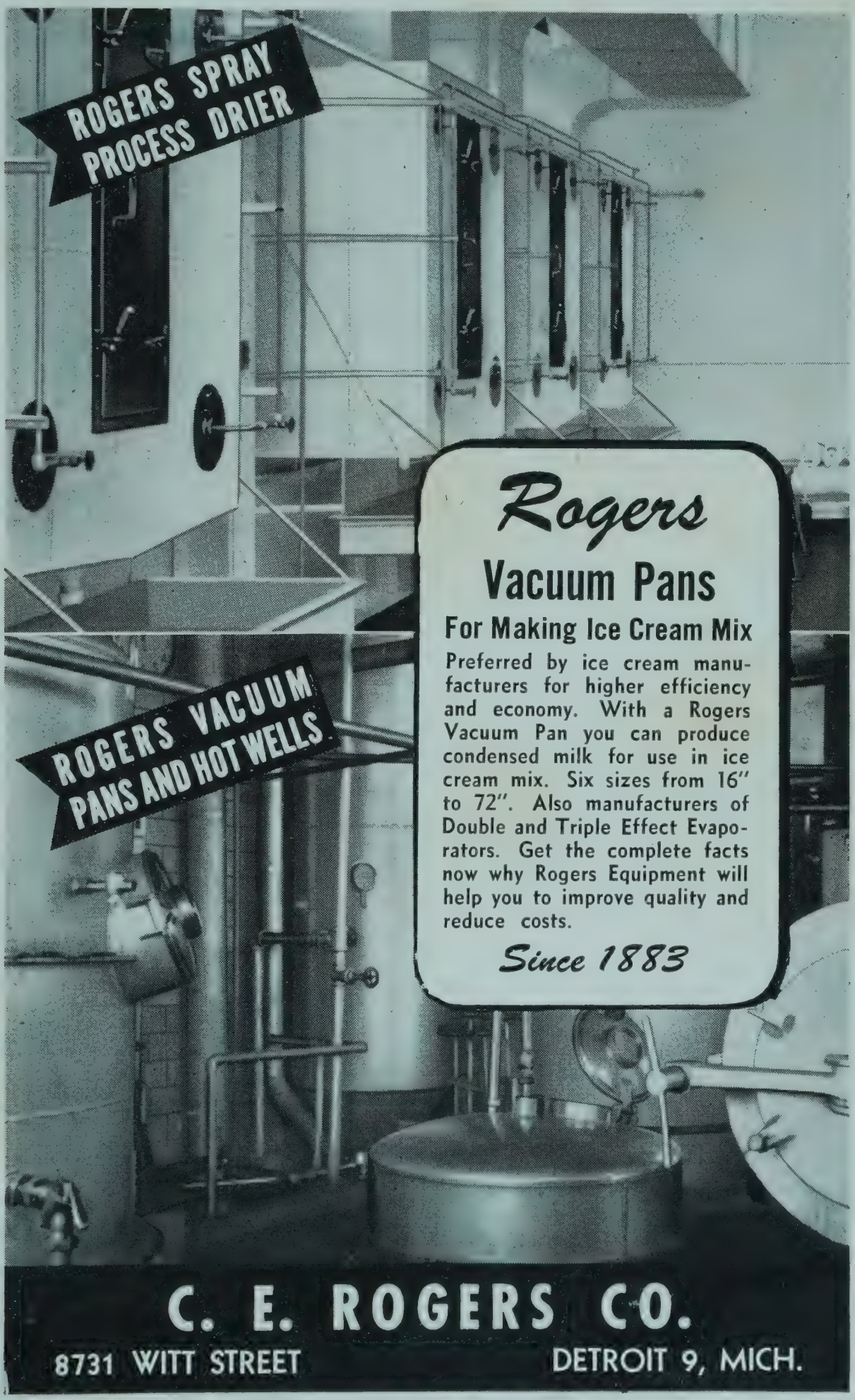
The Charles R. Phillips Company is old enough in years to merit the reputation it has earned for the manufacture of high quality flavors for the ice cream field.

It is young enough to be progressive . . . to be constantly striving in the laboratory for purer, finer flavors . . . thereby helping the ice cream industry make tastier, more flavorful products.

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Charles R. Phillips Co., Inc.


ROGERS SPRAY PROCESS DRIER
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Preferred by ice cream manufacturers for higher efficiency and economy. With a Rogers Vacuum Pan you can produce condensed milk for use in ice cream mix. Six sizes from 16" to 72". Also manufacturers of Double and Triple Effect Evaporators. Get the complete facts now why Rogers Equipment will help you to improve quality and reduce costs.
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Sugarnut

Contributions to the Industry

● *Sugarnut* has been a factor in the ice cream industry as long as it has been a significant part of our economy . . . ever since it was established as the Standard Extract Company in Louisville in 1890 . . . moved to Cincinnati in 1900 . . . succeeded by The Standard Fruit Product Company in 1913.

● All of the sixty years have been studded with diamonds of accomplishment to which *Sugarnut's* organization point with pride. Within 20 years after its founding by Swiss Chemist Edmund Luthy, the original nectar, vanilla, lemon, and synthetic fruits had been supplemented with fruit flavors which gave the company its present name.

● Standard then had perfected the very frozen food methods widely used today. *Sugarnut* Instant Chocolate was a bonanza for the soda fountains of that day . . . it made a miracle cup of hot chocolate *in less than 60 seconds.*

● In the next decade when fruit topping and concentrated syrups were appearing on ice cream menus, *Sugarnut* raspberry, orange, lemon and lime were made in copper kettles over furnaces fired with coke . . . a far cry from *Sugarnut's* modern plant today.

● As the heating process was known to reduce fruit flavors considerably, *Sugarnut's* research was finally crowned with success . . . and the industry enjoyed the advantage of *Sugarnut's* pioneering Cold Pack Ice Cream Fruits . . . *with a fresh fruit* flavor . . . which became *a staple with a good year 'round demand.*

● Rapid advancement was made by *Sugarnut* in the flavoring and coloring concrete (emulsion) phase. Some ice cream houses pioneering as chains used *Sugarnut* fruit extracts with the needed advantages of low price and flavor variety to put over their specialty ices and ice creams . . . *in all seasons.* In 1938 the industry welcomed *the first fruits prepared commercially for variegated sundae-type ice cream by Sugarnut. In* 1939 *Sugarnut was the first flavor house to prepare fruits and flavors and methods of manufacturing ice cream pies and tarts.* In 1941 *Sugarnut perfected the first puree canned bananas without synthetics.*

● Throughout its long history, Sugarnut experts have been a never-failing source of technical counsel in manufacturing problems of ice cream houses. *Whenever such a problem bothers you, ask Sugarnut to share its experience with you. Naturally there is no charge . . . it is a part of Sugarnut's service.*

THE STANDARD FRUIT PRODUCT COMPANY

208-210 Main Street — — — Phone MAin 3069

Cincinnati 2, Ohio

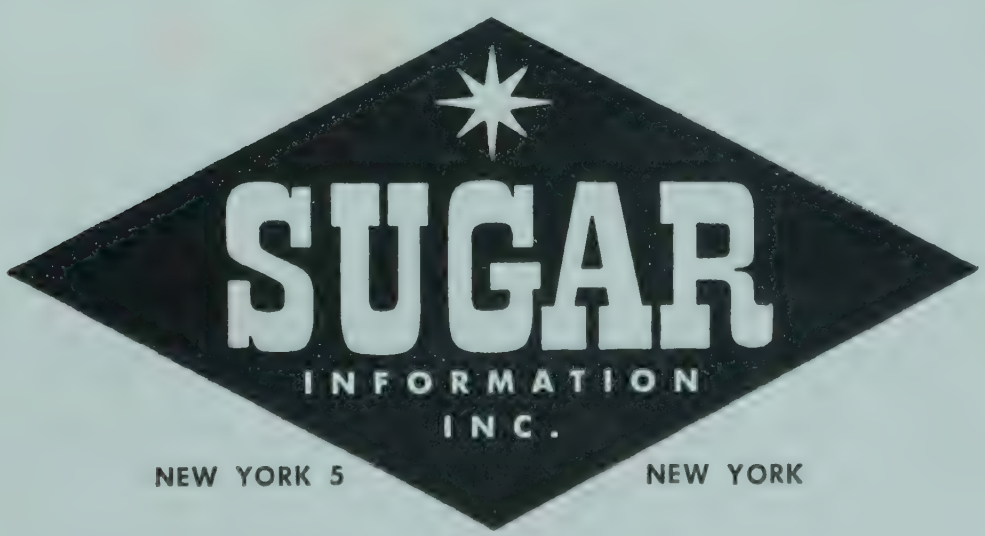
Sugar means top quality in Ice Cream

Ice cream manufacturers know from experience that sugar produces superior ice cream, in both texture and flavor. Because sugar gives body and brings out the best in flavor as no other sweetener can.

Sugar is economical. Pound for pound, it has 10% to 50% more sweetening power than other sweetening ingredients.

You can depend on uniform quality, too, for real sugar comes to you just as nature made it in the sugar cane and sugar beet.

Always use sugar in ice cream for full flavor—for the better value that means sales. There is no substitute for sugar.



Soft Ice Cream

FROM

SWEDEN SPEED FREEZERS

. . . the modern way to handle bulk ice cream business!

- Dispensed at peak flavor point—direct from freezer.
- Keeps ice cream food costs below 40% — permits popular low prices for all types of frozen desserts - malts - a la modes - - fountain specialties.
- Eliminates high cost steps in frozen dessert production and marketing—gives faster service, lower labor costs, ends dipping sanitation problems—AND BUILDS VOLUME!
- A model for every need—from gallon-a-day outlets to biggest stops in any area.



Model 1-131

the "fountain freezer"

Meet the competition of soft ice cream and frozen custard specialty stores by putting these profitable products in your own and your customers' stores. Plug volume losing leaks—and build NEW volume—by cashing in on the popularity of that delicious, freezer-fresh flavor. Large profit margins create top dealer interest in ALL ice cream merchandising. New equipment requirements are small, because Sweden models are designed to be installed and used in existing stores and fountains.

SWEDEN SPEED FREEZERS are sturdy, trouble-free, fully automatic. Especially designed to dispense thick, heavy products in appetizing servings. Batch and continuous models. Easy to operate. Easy to keep sanitary; designed to meet strictest health department requirements. Compact, requiring minimum floor space. Underwriters' approved. Gold Medal Winner at International Food Exposition, Brussels, Belgium. Write today for complete information on serving more ice cream at lower cost.

THE "FOUNTAIN FREEZER"

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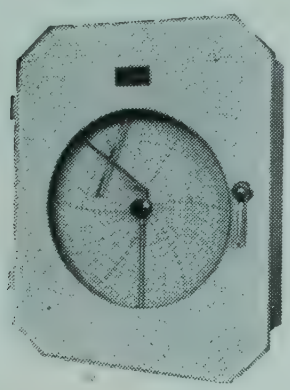
A MODEL TO MEET EVERY NEED

SWEDEN FREEZER MANUFACTURING COMPANY

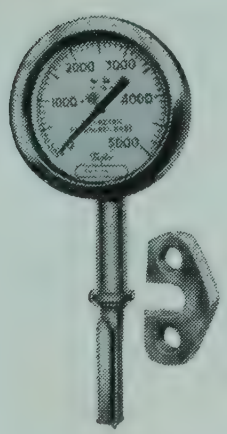
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QUALITY INSTRUMENTS FOR ICE CREAM MEN

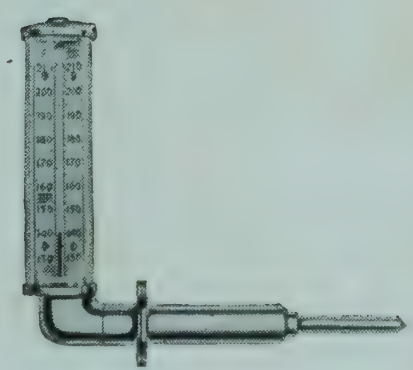
These precision-built Taylor Instruments are proven aids to Ice Cream Men. They are just a few of the many instruments made by the leader in the Dairy Industry.



For Hardening and Storage Rooms This accurate Taylor Recording Thermometer will give you a permanent, minute-by-minute temperature record so that you can be sure your ice cream is always being hardened and stored at proper temperatures. Mounts outside hardening room. Stainless steel connecting tubing extends through wall. Highly responsive, sensitive-type bulb located where it will be subjected to average temperature conditions.



For Homogenizers Taylor Volumetric Gage, with its fluted, sensitive element, gives an extremely accurate measurement of homogenizer pressure. Ruggedly constructed. Easy to read 4½″ dial. 18-8 stainless steel bulb and stem is easy to clean and imparts no flavor to product. Removable yoke-type flange allows gage to be faced in any direction for convenient reading. Also available as a recorder.



CLEANLINER* Thermometers For vats, storage tanks, pasteurizers, etc. These Taylor Cleanliner Thermometers are permanently easier to read and easier to clean. Pyrex glass case is hermetically sealed—keeps all moisture and dirt out. No fogging. No cracks or crevices to harbor bacteria. Wide variety of ranges available.

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ICE CREAM INGREDIENTS

DUO-LIZER

Duo-Lizer is a combination Stabilizer and Emulsifier. The emulsifier portion of Duo-Lizer is soluble in the butterfat fraction. The stabilizer is soluble in the water fraction of the mix.

The one emulsifies and stabilizes the butterfat: the other absorbs excess moisture and stabilizes the sugar and serum solids. This produces a mix of lower viscosity which will cut down whipping and freezing time, and produces a drier and firmer ice cream from the freezer. Net results are a smoother more evenly textured ice cream.

MONO-LIZER

Mono-Lizer is a uniform, laboratory controlled stabilizer for use in ice cream and frozen desserts. It is readily soluble in either hard or soft water and is not affected by the pH or acidity of the mix. Fruit acids or cocoa in the mix will not coagulate, precipitate or thicken Mono-Lizer.

The stabilizing action of Mono-Lizer is IMMEDIATE and gives ice cream superior physical characteristics.

GLDEN WHIP

Golden Whip is made from freshly broken domestic egg yolks and modified milk proteins which are blended together, then pasteurized, homogenized and vacuum dried. This produces a product uniform in color and efficiency—with decreased bacteria count and greater keeping qualities. It is a free flowing product that will readily disperse in your mix, and is instantly and completely soluble.

Golden Whip will replace egg yolk solids on a pound for pound basis.

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